



# Analysis of the Relationship between 2021-22 Star Assessment and Keystone Assessment Performance

*In Pennsylvania, high school students are required to take Keystone exams associated with Keystone courses; participation prior to graduation is required for federal accountability purposes. The School District of Philadelphia's Board of Education's Goal 4 is focused on improving the reading and math performance of grades 9-11 students on the Keystones. To track progress toward the Goal, the District examines the performance of students on "Leading Indicators," the within-year assessments of reading and math skills administered multiple times between the annual Keystone exams. This report examines the statistical relationship of Winter and Spring Star performance and Keystone performance in 2021-22.*

## Key Findings:

- About 90% of students who scored in the highest performance group on Star Reading also performed Proficient or Advanced on the Literature Keystone.
- About 70% of students who scored in the highest performance group on Star Math also performed Proficient or Advanced on the Algebra 1 Keystone.
- The positive predictive value (i.e., Winter and Spring Star predicting Keystone performance) was higher for reading assessments (90%-92%) than math assessments (72%), but the sensitivity (i.e., the accuracy of Star in predicting Keystone performance out of students who had proficient Keystone performance) was higher for math assessments (68%-69%) than reading assessments (56%-57%).
- Correlations between Star Unified Scale Scores and Keystone Scale Scores were strong between Star Reading and the Literature Keystone ( $r = 0.70-0.74$ ) and between Star Math and the Algebra 1 Keystone ( $r = 0.71-0.72$ ).

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March 2023

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### **Acknowledgements**

The authors would like to acknowledge the hard work and contributions of our colleagues in the School District of Philadelphia's Office of Evaluation, Research, and Accountability, and the District Performance Office for managing and processing the assessment data, as well as thought partnership, including: Allison Smith, Lucas Westmaas, Jason Leach, and Joanne Zhu. The authors also thank Ebru Erdem, Jenny Hoedeman-Eiteljorg, Joy Lesnick, Michael Frisone in the Office of Research and Evaluation Wyatt Cadley from the Planning and Evidence-based Supports Office for thought partnership, quality assurance, and lots of editing.

## Introduction

In the School District of Philadelphia (SDP), students in grades K-12 are administered formative (within-year) assessments in math and reading developed by Renaissance Star.<sup>1</sup> Students in grades 3-8 complete summative (end-of-year) state administered assessments called the PSSA,<sup>2</sup> and students in grades 8-12 take summative (end-of-course) state administered assessments called the Keystone exams.<sup>3</sup> In this report, we examine the relationship between high school student performance on within-year (Star assessments) and end-of-course (Keystone) exams.

### About the Star Assessments

SDP uses Star assessments, a suite of tests developed by Renaissance Learning, to assess students' reading and math skills. In 2021-22, Star assessments were administered to SDP students in grades K-12 four times (Fall, Winter 1, Winter 2, and Spring).<sup>4</sup> SDP students in grades 8-12 take Star computer adaptive tests, or CATs, for reading and math. Star CATs adjust the difficulty of items administered to the student depending on how well the student performed on previous items within a given testing session. These tests are designed to broadly assess students' skills across a number of literacy or math domains. The analyses will focus on the Winter 1 and Spring windows.

### About the Keystone Exams

In Pennsylvania, high school students are required to take three Keystone exams associated with three Keystone courses: Literature, Algebra 1, and Biology. Participating in these exams is required for state and federal accountability purposes.<sup>5</sup> High school students are expected to take the Keystone exams in the spring of the year they took the associated course (e.g., English 2, Algebra 1, Biology), and most often take the Keystone exams in 9<sup>th</sup>, 10<sup>th</sup>, and 11<sup>th</sup> grade, although 8<sup>th</sup> graders take the Algebra 1 Keystone if they completed Algebra 1 in 8<sup>th</sup> grade. Due to COVID-19, and subsequent cancellations or postponement of Keystone exams in 2019-20 to 2020-21, more students took the respective Keystone exam a year after they completed the course than pre-pandemic.

Starting with the graduating class of 2023, Keystone exam performance has become one of the pathways to graduation.<sup>6</sup> Students have the opportunity to retake the Keystones if they are not satisfied with their original score, and their best score on each Keystone exam by the end of 11<sup>th</sup> grade (referred to as *Best by 11<sup>th</sup>*) counts toward the graduation pathway. For the purposes of this analysis, only scores for Keystone exams that were taken during the 2021-22 school year and not

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<sup>1</sup> For more information about how the District uses Star, see: [philasd.org/era/assessment/star-information](https://philasd.org/era/assessment/star-information)

<sup>2</sup> For more information from the District about the PSSAs, see: [philasd.org/era/pssa-pasa-information/](https://philasd.org/era/pssa-pasa-information/)

<sup>3</sup> For more information from the District about the Keystones, see: [philasd.org/era/keystone-information/](https://philasd.org/era/keystone-information/)

<sup>4</sup> School Districts choose the number of administration windows and dates for Star assessments. SDP changed the number of required administration windows and dates between 2020-21, 2021-22, and 2022-23.

<sup>5</sup> For more information about the Keystones from the Pennsylvania Department of Education, see: <https://www.education.pa.gov/K-12/Assessment%20and%20Accountability/Keystones/Pages/default.aspx>

<sup>6</sup> Alternative pathways are available, for more information, see: [pdesas.org/Frameworks/DCEToolKit/Act158/PathwaysToGraduationToolkit](https://pdesas.org/Frameworks/DCEToolKit/Act158/PathwaysToGraduationToolkit). Students can also earn a composite score that is the equivalent of scoring Proficient or Advanced on all three Keystones.



Best by 11<sup>th</sup> scores were included. It is ideal to compare Star assessment and Keystone exam performance taken in the same school year rather than different school years so that there is more appropriate alignment between assessments based on student learning or skill level.

## Star Performance as Leading Indicators for Keystone Performance

In 2020-21, the SDP Board of Education established Goals and Guardrails that outline what SDP students must know and be able to accomplish, and describe the conditions needed in each school to empower all students to succeed in school and after graduation.<sup>7</sup>

The SDP Board of Education's Goal 4 is focused on improving the reading and math performance of grades 9-11 students on the Keystone exams:

*Goal 4: The percentage of students who are proficient on all three state high school assessments (Algebra, Literature, and Biology) by the end of their 11<sup>th</sup> grade year will grow from 26.1% in August 2019 to 52.0% by August 2026.*

To track progress toward the Goal, the District examines the overall performance of student groups on "Leading Indicators," which are within-year assessments of reading and math performance that are administered multiple times in the school year between the annual Keystone exams.<sup>8</sup> The District uses performance on the Leading Indicators to provide information about how students are progressing toward end-of-year targets. For example, the percentage of students scoring at or above grade-level on the within-year assessment can be used to estimate the percentage of students scoring Proficient or Advanced on the Keystones. If there is growth in the percentage of students scoring at or above grade-level on the District's within-year reading and math assessments that are administered multiple times per year, then the percentage of students who score in the Proficient and Advanced categories on the Keystone exams should similarly increase.

*Leading Indicator 4.1: The percentage of students in grades 9-11 who score at or above grade level on the District's within-year math and reading assessments (Star) in Fall, Winter, and Spring each year.*

## Research Questions

This report examines the statistical relationship between student-level Star performance and Keystone performance during the 2021-22 school year by focusing on the performance group overlap and predictive values of Star Reading and Math assessments in Winter and Spring of 2021-22. It is hypothesized that Spring Star assessments (May 16 – June 14) should have better alignment to the Keystones (May 16 – 27) because they are taken during the same time of year. Winter Star assessments (December 1 – 23) may have a lower statistical alignment with the Keystones, because they are administered five months prior, and teachers and District staff

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<sup>7</sup> For more information about the Goals and Guardrails, see: [www.philasd.org/schoolboard/goals-and-guardrails/](http://www.philasd.org/schoolboard/goals-and-guardrails/), [www.philasd.org/goalsandguardrails/](http://www.philasd.org/goalsandguardrails/), and [www.philasd.org/era/goals-and-guardrails/](http://www.philasd.org/era/goals-and-guardrails/)

<sup>8</sup> For more information about Goal 4 and Leading Indicator 4.1, including data, visit: <https://www.philasd.org/era/goals-and-guardrails/#1652464878742-79d652ff-c120>

typically use Winter Star performance to adjust instructional practices and implement interventions for students who are not scoring at or above grade-level on Star in Winter.

Four sets of analyses are reflected in four research questions that are aligned with the SDP Board of Education's Goal 4. Students do not take a within-year science assessment, so we do not examine performance on the Biology Keystone exam in this report.

1. What is the relationship between 2021-22 Winter Star Reading performance and 2021-22 Literature Keystone performance for students in grades 9-11?
2. What is the relationship between 2021-22 Spring Star Reading performance and 2021-22 Literature Keystone performance for students in grades 9-11?
3. What is the relationship between 2021-22 Winter Star Math performance and 2021-22 Algebra 1 Keystone performance for students in grades 8-11?
4. What is the relationship between 2021-22 Spring Star Math performance and 2021-22 Algebra 1 Keystone performance for students in grades 8-11?

## Methods

### Metrics

For each research question, students are included if they took both the relevant 2021-22 Keystone exam<sup>9</sup> and the corresponding Star assessment during the assessment window of interest (either Winter or Spring). For example, an analysis of 2021-22 Literature Keystone performance and Winter 2021-22 Star Reading performance includes any student who took both the Literature Keystone exam in 2021-22 and the Star Reading assessment in the 2021-22 Winter testing window.

Therefore, the analysis for each research question includes slightly different student samples. As long as students have the two required data points (both a Keystone record in the relevant subject *and* a Star record in the relevant subject and testing window) for each respective research question, those students are included in that question's analysis (Figure 1).

### Keystones

The Keystone exams provide multiple metrics that describe student performance. Keystones are administered for Algebra 1, Literature, and Biology. For this set of analyses, only data for Literature and Algebra 1 Keystone exams were included, to more closely align with Reading and Math Star assessments. The Keystone metrics used in this analysis are the Scale Score and performance groups.

#### *Scale Score*

Keystone exam scores are scaled using an item response theory (IRT) model that accounts for the difficulty of the items, and Scale Scores range from 1200-1800.

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<sup>9</sup> Students who participated in the 2020-21 Keystone exams in Fall 2021 (delayed due to Covid-19) were counted in the 2020-21 Keystone data and are not included in these analyses. Students who took the Keystones in Winter or Spring 2021-22 count toward the 2021-22 Keystone record and are included in these analyses.

*Performance Groups*

The Keystone performance group metric provides information about student performance in four categories: Advanced, Proficient, Basic, and Below Basic. Performance groups are based on whether students' Scale Scores fall within the range for that performance group, according to the established cut points for each performance group (Table 1). To achieve proficiency on a Keystone exam, students must score in the Proficient or Advanced range; that is, above 1500.

Table 1. Keystone performance groups and Scale Score ranges

<b>Performance Group</b>	<b>Literature Keystone</b>	<b>Algebra 1 Keystone</b>
Advanced	1584-1800	1546-1800
Proficient	1500-1583	1500-1545
Basic	1444-1499	1439-1499
Below Basic	1200-1443	1200-1438

**Source:** Pennsylvania Department of Education

**Star**

The Star Reading and Star Math Computer Adaptive Tests (CATs) provide several metrics that describe student performance. The metrics used in this analysis are the Star Unified Scale Score and Star performance groups.

*Unified Scale Score*

The Star Scale Scores are reported on the Star Unified Scale.<sup>10</sup> The Unified Scale is based on an IRT model that accounts for the difficulty of the items administered when scoring student performance. The Unified Scale is also a vertical scale, meaning that scores reported on this scale can be used to compare student performance across grades and to track student growth over time. The Unified Scale is scaled for grades K-12 with scores ranging from 600-1400 for Star Reading and Star Math.

*Performance Groups*

The Star performance groups metric provides information about student performance in four categories: At/Above Benchmark, On Watch, Strategic Intervention, and Intensive Intervention. They are based on the student's national percentile rank (NPR), which compares a student's Unified Scaled Score against a nationally representative sample of students who are in the same grade and who took the same CAT at roughly the same time. Table 2 provides the Unified Scaled Score cut points for grades and assessment windows separately, because the relationship between NPR and Unified Scaled Scores are different for each grade level and at different times of the year.

<sup>10</sup> For more information about the Star Scale in 2021-22, visit: [www.philasd.org/research/2022/06/09/star-tests-in-the-school-district-of-philadelphia-a-summary-of-metrics-that-describe-achievement-and-growth/](http://www.philasd.org/research/2022/06/09/star-tests-in-the-school-district-of-philadelphia-a-summary-of-metrics-that-describe-achievement-and-growth/)

Table 2. Star performance groups and Unified Scale Score cut points for 2021-22 in SDP

Subject	Performance Group	Winter			Spring				
		9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade	9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade		
Reading	At/Above Benchmark (≥ 40 <sup>th</sup> NPR)	1119	1128	1134	1125	1131	1139		
	On Watch (25 <sup>th</sup> to 39 <sup>th</sup> NPR)	1090	1100	1105	1097	1102	1110		
	Strategic Intervention (10 <sup>th</sup> to 24 <sup>th</sup> NPR)	1047	1058	1061	1056	1059	1067		
Subject	Performance Group	Winter				Spring			
		8 <sup>th</sup> grade	9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade	8 <sup>th</sup> grade	9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade
Math	At/Above Benchmark (≥ 70 <sup>th</sup> NPR)	1137	1139	1141	1153	1148	1147	1150	1159
	On Watch (25 <sup>th</sup> to 69 <sup>th</sup> NPR)	1052	1059	1059	1074	1063	1068	1068	1079
	Strategic Intervention (10 <sup>th</sup> to 24 <sup>th</sup> NPR)	1002	1011	1008	1031	1015	1025	1022	1035

**Note:** NPR is National Percentile Rank and compares a student’s Unified Scale Score against a nationally representative sample of students who are in the same grade and who took the same CAT at roughly the same time. Intensive Intervention is any NPR below the 10<sup>th</sup> percentile. Unified Scale Score cut points included in this table are estimates based on the Winter and Spring assessment window dates. Star calculates different cut points based on the date students take Star; students who take Star later have to meet higher Unified Scale Score cut point thresholds to be included in a specific performance group than students who take Star earlier.

**How to read this table:** This table displays the minimum scores, or cut scores, for each performance group for each relevant grade in the two assessment windows in this analysis, Winter and Spring. For example, a 9<sup>th</sup> grader with a Star Reading score of 1119 in Winter scored in the At/Above Benchmark group (the highest Star performance group). However, if the student has the same score on Star Reading for Spring, they would score in the On Watch performance group because in Spring a minimum score of 1125 is required for 9<sup>th</sup> graders to score in the At/Above Benchmark group on Star Reading.

## Sample

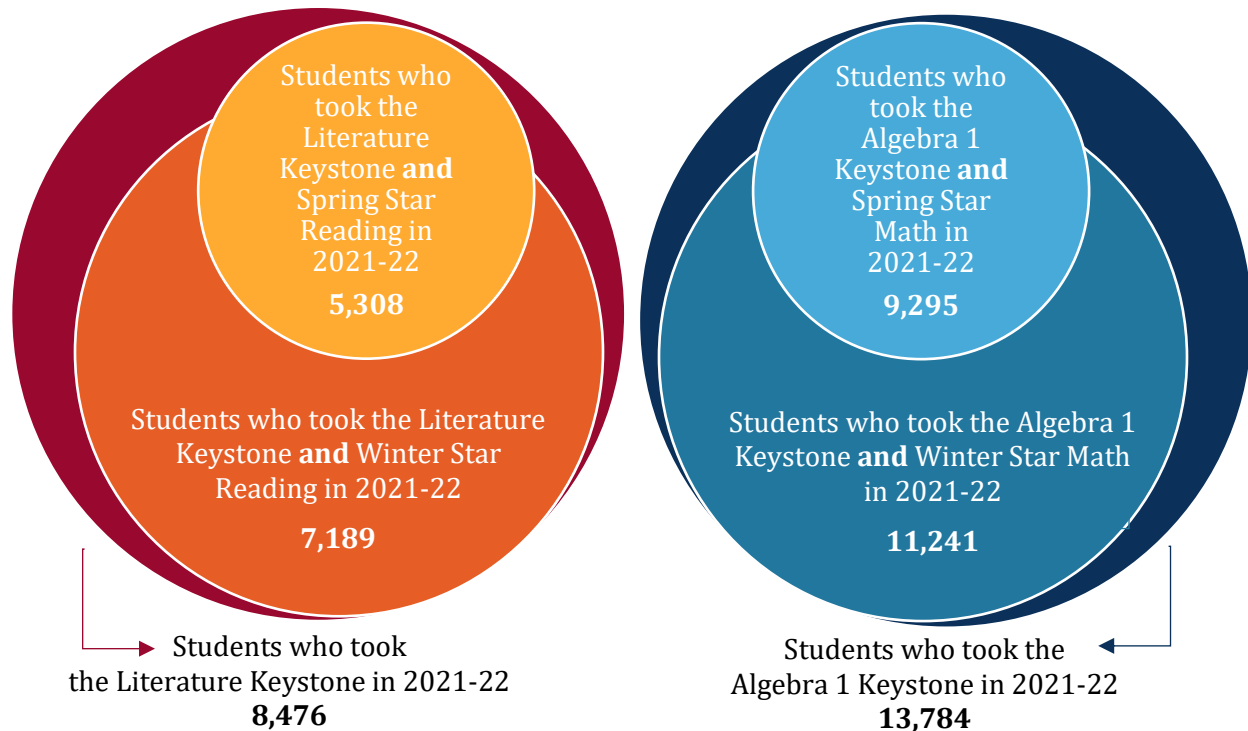
Students are included in each of the four sets of seasonal (Winter Star and Spring Star) and subject (Star Reading/Literature Keystone and Star Math/Algebra 1 Keystone) analyses as long as they have the required data points for each analysis. For the reading analyses, students must have a 2021-22 Literature Keystone score (taken at any point as part of the 2021-22 assessment year),<sup>11</sup> plus a Winter Star Reading score to be in the Winter analysis, and a Spring Star Reading score to be in the Spring analysis. This means that the Winter and Spring analyses samples have similar students—the students who took both the Winter and Spring Star Reading—but not the same groups of students (Figure 1). For example, students who took the Winter Star Reading but did not take the Spring Star Reading are included in the Winter analysis but not the Spring. The same rules apply for the math analyses.

<sup>11</sup> Students who did not take either the Literature or Algebra 1 Keystone in 2021-22 are not included.

Over 8,000 students took the Literature Keystone in 2021-22 (Figure 1). Of students who took the Literature Keystone in 2021-22, 7,189 students also took the Winter Star Reading, and 5,308 students also took the Spring Star Reading. Some of these students are the same—they took both the Winter and Spring Star Reading; however, some students only took the Winter Star Reading and did not take the Spring, and some students did not take the Winter and only took the Spring.

Similarly, over 13,000 students took the Algebra 1 Keystone in 2021-22 (Figure 1). Of the students who took the Algebra 1 Keystone, 11,241 took the Winter Star Math, and 9,295 took the Spring Star Math. Some of these students are the same—they took both the Winter and Spring Star Math; however, some students only took the Winter Star Math and did not take the Spring, and some students did not take the Winter Star Math and only took the Spring.

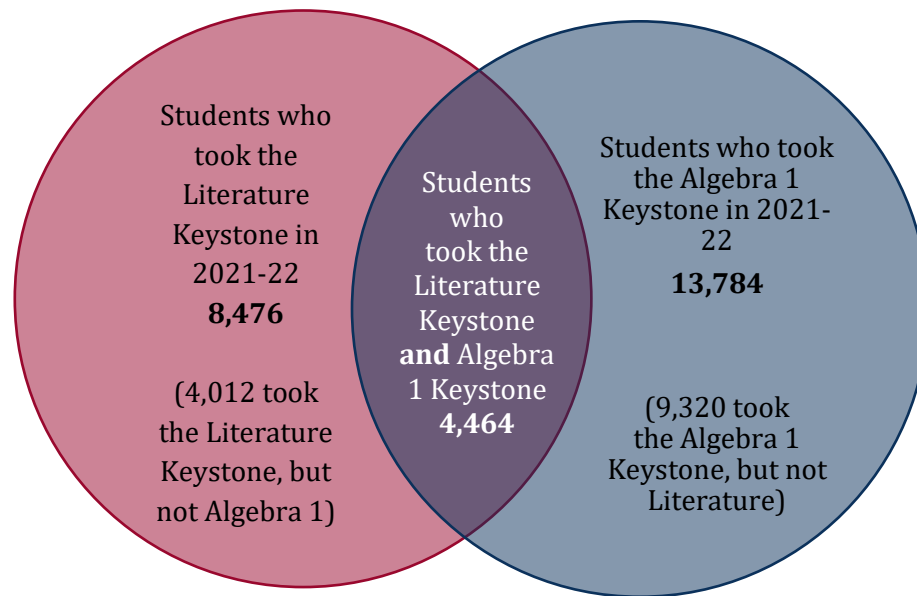
Figure 1. The number of students who took the Literature or Algebra 1 Keystone exams in 2021-22, and the number of students who took the Keystone exams and also took the Star Reading and Math assessments in either the Winter or Spring 2021-22 Star assessment windows



**Note:** The numbers in this figure are the same as in Table 3.

Additionally, 4,464 students took both the Literature Keystone and the Algebra 1 Keystone, and are thus part of the denominator for both the reading analyses and the math analyses (Figure 2). This means that 4,012 students took the Literature Keystone but not the Algebra 1 Keystone and are thus only included in the reading analyses, and 9,320 students took the Algebra 1 Keystone but not the Literature Keystone and are thus only included in the math analyses.

Figure 2. The number of students who took the Literature or Algebra 1 Keystone exams, or both exams, in 2021-22



While 10<sup>th</sup> grade students accounted for 71% of all SDP students with Literature Keystone scores, they represented 73%-76% of all SDP students with *both* Literature Keystone and Star Reading scores in the Winter and/or Spring assessment windows (Table 3). Similarly, 9<sup>th</sup> grade students accounted for 52% of all SDP students with Algebra 1 Keystone scores and represented 54% of all SDP students with *both* Algebra 1 Keystone and Star Math scores in the Winter and/or Spring windows.

Additionally, while 11<sup>th</sup> grade students accounted for 26% of all SDP students with Literature Keystone scores in 2021-22, they represented just 21%-24% of all SDP students with *both* Literature Keystone and Star Reading scores in the Winter and/or Spring assessment windows. Additionally, of all SDP students with Algebra 1 Keystone scores, 26% were 10<sup>th</sup> graders and 13% were 11<sup>th</sup> graders, but those same groups only represented 23%-24% and 11%-12% of all SDP students with *both* Algebra 1 Keystone and Star Math scores in the Winter and/or Spring windows, respectively.

Looking at students just by grade level, the sample of students who took both Star and the Keystones is close, but not representative of the total population of students who took the Keystones. Spring analyses have a slight overrepresentation of 10<sup>th</sup> graders for the Literature Keystone and Star Reading analyses and a slight overrepresentation of 9<sup>th</sup> graders for the Algebra 1 Keystone and Star Math analyses. This is a limitation of this analysis.

Table 3. Percentage of students included in each analysis by student group (students who took Star are subsets of students who took the Keystones)

Student Group	Students who took the Literature Keystone in 2021-22			Students who took the Algebra 1 Keystone in 2021-22		
	All 9-12 students who took Literature Keystone	Students with Winter Star Reading Score	Students with Spring Star Reading Score	All 8-12 students who took Algebra 1 Keystone	Students with Winter Star Math Score	Students with Spring Star Math Score
<b>Number of students</b>	8,476	7,189	5,308	13,784	11,241	9,295
<b>Grade Level</b>						
<b>8</b>	N/A	N/A	N/A	9%	10%	12%
<b>9</b>	2%	2%	2%	52%	54%	54%
<b>10</b>	71%	73%	76%	26%	24%	23%
<b>11</b>	26%	24%	21%	13%	12%	11%
<b>12</b>	2%	0%	0%	9%	N/A	N/A
<b>Race/Ethnicity</b>						
<b>Asian</b>	12%	13%	14%	12%	14%	15%
<b>Black/African American</b>	50%	49%	49%	47%	47%	45%
<b>Hispanic/Latinx</b>	20%	20%	19%	23%	21%	21%
<b>Multi-Racial/Other</b>	4%	4%	5%	5%	5%	5%
<b>White</b>	13%	14%	14%	13%	14%	14%
<b>Gender</b>						
<b>Female</b>	51%	51%	53%	52%	53%	53%
<b>Male</b>	49%	48%	47%	48%	47%	47%
<b>Economic Disadvantage Status</b>						
<b>Economically Disadvantaged</b>	67%	66%	65%	67%	67%	66%
<b>Not Economically Disadvantaged</b>	33%	34%	34%	33%	33%	34%
<b>Special Education Status</b>						
<b>Has IEP</b>	14%	12%	12%	14%	13%	12%
<b>Does not have IEP</b>	86%	88%	88%	86%	87%	88%
<b>English Learner Status</b>						
<b>English Learner</b>	13%	13%	10%	18%	15%	16%
<b>Non-English Learner</b>	87%	87%	90%	82%	85%	84%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** The values in the columns *Students with Winter/Spring Star Reading/Math Score* are subsets of the values in the columns *All students in 8-12/9-12 who took Literature/Algebra 1 Keystones*. N/A indicates there are no students in the sample in the student group. Cells with 0% include between 1 to 18 students due to rounding. The American Indian/Alaskan Native population and Native Hawaiian/Pacific Islander populations are included in the Multi-Racial/Other. Non-Binary students made up less than 1% of the population. Students over 18 do not have an Economic Disadvantage Status provided by the state, and therefore are included in the Not Economically Disadvantaged group, which may be artificially inflating the size of the Not Economically Disadvantaged group. IEPs are Individualized Education Plans provided to students who receive Special Education services.

## Data Analysis

Two main analyses were completed to investigate the research questions listed above.

First, cross-tabulations of Star performance groups and Keystone performance groups were conducted for the Star Winter and Spring windows. The cross-tabulations were used to describe alignment and accuracy of Star in predicting Keystone performance. Analyses of the following values are included (See Box 1 for more information):

- **Positive Predictive Values:** What is the likelihood that a student who scores At/Above Benchmark on Star will score Proficient/Advanced on the Keystone?
- **Negative Predictive Values:** What is the likelihood that a student who does not score At/Above Benchmark on Star will not score Proficient/Advanced on the Keystone?
- **Sensitivity:** What is the likelihood that a student who scores Proficient/Advanced on the Keystone will be “correctly” classified by scoring At/Above Benchmark on Star?
- **Specificity:** What is the likelihood that a student who does not score Proficient/Advanced on the Keystone will be “correctly” classified by not scoring At/Above Benchmark on Star?



### Box 1: Calculating Classification Accuracy Metrics

There are numerous classification accuracy metrics used in this report. This box provides more detail about the metrics and how they are calculated in the context of the current report.

		Keystone	
		Proficient/Advanced	Basic/Below Basic
Star	At/Above	A	B
	Not At/Above	C	D

- **Sensitivity** =  $\frac{A}{A+C}$ ; the proportion of students who scored Proficient/Advanced on the Keystone who were correctly classified as At/Above Benchmark by Star out of all students who scored Proficient/Advanced on Keystone
- **Specificity** =  $\frac{D}{B+D}$ ; the proportion of students who did not score Proficient/Advanced on Keystone who were correctly classified as On Watch, Strategic Intervention, and Intensive Intervention by Star out of all students who did not score Proficient/Advanced
- **Correct Classifications** =  $\frac{A+D}{A+B+C+D}$ ; the proportion of students who were identified by Star as At/Above Benchmark and scored Proficient/Advanced on Keystone, and students who were identified by Star as On Watch, Strategic Intervention, and Intensive Intervention and scored Basic/Below Basic
- **Prevalence** =  $\frac{A+C}{A+B+C+D}$ ; the proportion of students who scored Proficient/Advanced on the Keystone out of all students who took the Keystone, regardless of how they scored on Star
- **Positive predictive value** =  $\frac{A}{A+B} = \frac{\text{sensitivity} \times \text{prevalence}}{\text{sensitivity} \times \text{prevalence} + (1 - \text{specificity}) \times (1 - \text{prevalence})}$ ; the proportion of students who scored At/Above on Star who also scored Proficient/Advanced on the Keystone out of everyone who scored At/Above on Star
- **Negative predictive value** =  $\frac{D}{C+D} = \frac{\text{specificity} \times (1 - \text{prevalence})}{\text{specificity} \times (1 - \text{prevalence}) + (1 - \text{sensitivity}) \times \text{prevalence}}$ ; the proportion of students who **did not** score At/Above on Star who also **did not** score Proficient/Advanced on the Keystone out of everyone who scored On Watch, Strategic Intervention, and Intensive Intervention on Star

**Sources:** Akobeng, A. K. (2007). Understanding diagnostic tests 1: Sensitivity, specificity, and predictive values. *Acta Paediatrica*, 96, 338-341. [doi.org/10.1111/j.1651-2227.2006.00180.x](https://doi.org/10.1111/j.1651-2227.2006.00180.x). Altman, D. G., & Bland, J. M. (1994). Diagnostic tests 2: Predictive values. *The BMJ*, 309, 102. [doi.org/10.1136/bmj.309.6947.102](https://doi.org/10.1136/bmj.309.6947.102). Trevethan, R. (2017). Sensitivity, specificity, and predictive values: Foundations, pliabilities, and pitfalls in research and practice. *Frontiers in Public Health*, 5(307), 1-7. [doi.org/10.3389/fpubh.2017.00307](https://doi.org/10.3389/fpubh.2017.00307).

The second set of analyses involved estimating correlations between Star Unified Scale Scores and Keystone Scale Scores by subject, grade level, and testing window to better understand the linear relationship between Star and Keystone (see Box 2 for more information about correlations).

### Box 2: Understanding Correlations

Correlations are statistical analyses that describe the extent to which two variables are aligned with each other. Correlations can typically only be conducted with two variables on a large scale, like Scale Scores that range from 1 - 2000, and are typically not appropriate when comparing distinct groups to each other. Correlation results range from -1.0 to 0 to +1.0.

Traditional wisdom considers the following strength of Pearson r-correlations:

Strength:	very weak	weak	moderate	strong	very strong
r-values:	0.0-0.19	0.2-0.39	0.40-0.59	0.6-0.79	0.8-1.0

Correlations can be positive or negative. We would anticipate correlations to be positive if they are measuring the same constructs (e.g., Reading and Literature). In the results in the current report, all correlations are positive.

**Source:** Rosenthal, R. (1991). *Meta-analytic procedures for social research* (Rev. ed). Newbury Park: Sage Publications.

## Results

### Descriptive Analyses

The percentage of students in the sample who scored in each Keystone and Star performance group was generally consistent between the two Star Assessment windows (Table 4 and Table 5).

Of students who took the Literature Keystone and the Winter Star Reading assessment, 45% scored in the Proficient or Advanced categories on the Keystone, and 29% scored in the At or Above Benchmark category on Star (Table 4). Similarly, of students who took the Literature Keystone and the Spring Star Reading assessment, 47% scored in the Proficient or Advanced categories on the Keystone, and 29% scored in the At or Above Benchmark category on Star. For both windows, a higher percentage of students score Proficient or Advanced on the Keystone than At or Above Benchmark on Star. It should be noted that about 1,800 fewer students took the Spring Star assessment than the Winter Star assessment.

Critically, out of all students District-wide who took the Literature Keystone, only 85% took the Winter Star Reading, and 63% took Spring Star Reading. *This means that this analysis only includes about 75% of students who took the Literature Keystone District-wide and thus may not fully represent the connection between Star and Keystone.* Out of all students District-wide who took the Literature Keystone in 2021-22 (regardless of whether they took Star Reading or not), 42% scored in the Proficient or Advanced categories on the Keystone; this is three to five percentage points lower than for students who took both the Literature Keystone and Star Reading.

Table 4. Percentage of students who scored in each Literature Keystone and Reading Star performance group by Star Assessment Window

Reading Star Window	n	Keystone				Star			
		Adv	Prof	Basic	Below Basic	At or Above	On Watch	Strategic	Intensive
Winter	7,189	5%	40%	33%	22%	29%	14%	19%	38%
Spring	5,302	5%	42%	32%	20%	29%	13%	19%	40%
All students	8,476	5%	37%	34%	24%	N/A	N/A	N/A	N/A

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**How to read this table:** This table presents the percentage of students who scored in each Literature Keystone and Reading Star performance group by Star Assessment Window in the sample for the respective analyses. Because different numbers of students took the Star Reading assessments in the Winter and Spring windows, the n-counts are different. For example, out of the 7,189 students who took the Literature Keystones and the Winter Star Reading assessment, 5% of students scored in the Advanced category on Keystones and 40% scored in the At or Above Benchmark category on Star. Similarly, out of the 5,302 students who took the Literature Keystones and the Spring Star Reading assessment, 5% of students scored in the Advanced category on Keystones, and 42% scored in the At or Above Benchmark category on Star. Additionally, the final row shows the percentage of students who scored in each Literature Keystone performance group, regardless of whether they took Star Reading or not.

**Note:** *All students* are all students who took the Literature Keystone in 2021-22, regardless of if they took the Star Reading in Winter or Spring.

In comparison, of students who took the Algebra 1 Keystone and Winter Star Math assessment, 20% scored in the Proficient or Advanced categories on the Keystone, and a similar percentage (19%) scored in the At or Above Benchmark category on Star (Table 5). Additionally, of students who took the Algebra 1 Keystone and the Spring Star Math assessment, 22% scored in the Proficient or Advanced categories on Keystone, and 21% scored in the At or Above Benchmark category on Star. Note that about 2,000 fewer students took the Spring Star assessment than the Winter Star assessment.

Here again, out of all students District-wide who took the Algebra 1 Keystone, only 82% took the Winter Star Math, and 67% took Spring Star Math. *This means that this analysis only includes about 75% of students who took the Algebra 1 Keystone District-wide, and thus may not fully represent the connection between Star and Keystones.* Out of all students District-wide who took the Algebra 1 Keystone in 2021-22 (regardless of whether they took Star Math or not), 18% scored in the Proficient or Advanced categories on the Keystone; this is two to four percentage points lower than for students who took both the Algebra 1 Keystone and Star Math.

Table 5. Percentage of students who scored in each Algebra 1 Keystone and Math Star performance group by Star Assessment Window

Math Star Window	n	Keystone				Star			
		Adv	Prof	Basic	Below Basic	At or Above	On Watch	Strategic	Intensive
Winter	11,241	8%	12%	37%	43%	19%	39%	17%	25%
Spring	9,295	9%	13%	37%	41%	21%	36%	15%	28%
All students	13,784	7%	11%	35%	48%	N/A	N/A	N/A	N/A

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**How to read this table:** This table presents the percentage of students who scored in each Algebra 1 Keystone and Math Star performance group by Star Assessment Window in the sample for the respective analyses. Because different numbers of students took the Star Math assessments in the Winter and Spring windows, the N-counts are different. For example, out of the 11,241 students who took the Algebra 1 Keystone and the Winter Star Math assessment, 8% of students scored in the Advanced category on the Keystone, and 19% scored in the At or Above Benchmark category on Star. Similarly, out of the 9,295 students who took the Algebra 1 Keystone and the Spring Star Math assessment, 9% of students scored in the Advanced category on the Keystone, and 21% scored in the At or Above Benchmark category on Star. Additionally, the final row shows the percentage of students who scored in each Algebra 1 Keystone performance group, regardless of whether they took Star Math or not.

**Note:** All students are all students who took the Algebra 1 Keystone in 2021-22, regardless of if they took the Star Math in Winter or Spring.

## What is the relationship between 2021-22 Winter Star Reading performance and 2021-22 Literature Keystone performance for students in grades 9-11?

**Scoring At/Above Benchmark on Winter Star Reading had a 90% positive predictive value for scoring Proficient or Advanced on the Literature Keystone.**

Of all grades 9-11 students who took both the Literature Keystone and the Winter Star Reading in 2021-22, 90% of students who scored At/Above Benchmark (the highest performance group) on Star Reading also scored Proficient or Advanced on the Literature Keystone (Table 6). This means that scoring At/Above Benchmark on Winter Star Reading had a 90% **positive predictive value** for scoring Proficient or Advanced on the Literature Keystone (Box 3).

### Box 3: Positive and Negative Predictive Values

This box summarizes information on positive predictive values and negative predictive values originally described in Box 1.

**Positive predictive value** is the proportion of students who scored At/Above Benchmark on Star and also scored Proficient/Advanced on the Keystone, divided by everyone who scored At/Above Benchmark on Star.

**Negative predictive value** is the proportion of students who **did not** score At/Above on Star and also **did not** score Proficient/Advanced on the Keystone, divided by everyone who **did not** score At/Above on Star.

In comparison, 73% of students who scored On Watch, Strategic Intervention, or Intensive Intervention on Winter Star Reading also scored Basic or Below Basic on the Literature Keystone. Thus, scoring lower than At/Above Benchmark on Winter Star Reading had a 73% **negative predictive value** for scoring lower than Proficient or Advanced on the Literature Keystone (Box 3).

Table 6. Positive and Negative Predictive Values: Percentage of students scoring Proficient or Advanced on the Literature Keystone by whether they scored At or Above Benchmark on Winter Star Reading in 2021-22

Winter Star Performance Groups	Number of Students	Keystone Performance Groups	
		Proficient or Advanced	Basic or Below Basic
At/Above Benchmark	2049	90%	10%
On Watch, Strategic, and Intensive	5155	27%	73%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale score in the Winter 1 testing window. This includes all students with a Literature Keystone score, regardless of whether they were enrolled in the Keystones Literature course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. See Table A1 for breakouts by On Watch, Strategic Intervention, and Intensive Intervention Star performance groups. See Appendix C for the same analysis for students who took the Keystones Literature course during the 2021-22 school year. The percentages in the rows sum to 100%, and the n-counts in each cell can be calculated by multiplying the percentages in the cell by the numbers in the *Number of Students* column.

**How to read this table:** This table presents the number of students who scored in At/Above or not At/Above Star performance groups, and the percentage of students in each Star performance group who scored in the Proficient or Advanced Keystone performance groups or the Basic or Below Basic Keystone performance groups. For example, 90% of students who scored At/Above in Star also scored Proficient or Advanced on Keystone.

Of all students in grades 9-11 who took both the Literature Keystone and the Winter Star Reading Assessment in 2021-22, 57% who scored Proficient or Advanced on the Literature Keystone also scored At/Above Benchmark (the highest performance group) on Star Reading (Table 7). This indicates 57% **sensitivity**, meaning students who scored Proficient or Advanced on the Literature Keystone were “correctly” identified by also scoring At/Above Benchmark on Winter Star Reading 57% of the time.

### Box 4: Sensitivity and Specificity Values

This box summarizes information on sensitivity and specificity originally described in Box 1.

**Sensitivity** is the proportion of students who scored Proficient/Advanced on the Keystone and also scored At/Above Benchmark on Star, divided by everyone who scored Proficient/Advanced on the Keystone.

**Specificity** is the proportion of students who scored Basic/Below Basic on the Keystone and also **did not score** At/Above Benchmark on Star, divided by everyone who scored Basic/Below Basic on the Keystone.

In comparison, 95% of the students who scored in Basic or Below Basic on the Literature Keystone also scored in On Watch, Strategic Intervention, or Intensive Intervention on Star Reading. This indicates 95% **specificity**, meaning students who scored lower than Proficient or Advanced on the Literature Keystone were “correctly” identified by also scoring lower than At/Above Benchmark on Winter Star Reading 95% of the time.

Table 7. Sensitivity and Specificity: Percentage of students scoring At/Above Benchmark or not on Winter Star Reading by whether they Score Proficient or Advanced on the Literature Keystone in 2021-22

Keystone Performance Groups	Number of Students	Winter Star Performance Groups	
		At/Above Benchmark	On Watch, Strategic, and Intensive
<b>Proficient or Advanced</b>	3222	57%	43%
<b>Basic or Below Basic</b>	3982	5%	95%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Winter 1 testing window. This includes all students with a Literature Keystone score, regardless of whether they were enrolled in the Keystones Literature course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. The percentages in the rows sum to 100%, and the n-counts in each cell can be calculated by multiplying the percentages in the cell by the numbers in the *Number of Students* column.

**How to read this table:** This table presents the number of students who scored in the Proficient or Advanced Keystone performance groups or the Basic or Below Basic Keystone performance groups, and the percentage of students in both Keystone performance groups who scored in the At/Above or not At/Above Star performance groups. For example, 57% of students who scored Proficient or Advanced on Keystone also scored At/Above in Star.

Across the entire sample, there was a 12% difference in the percentage of students who scored Proficient or Advanced on the Literature Keystone (40%) and who scored in the Winter Star Reading At/Above Benchmark performance group (28%) (Table 8). A higher percentage of students scored Proficient/Advanced on the Keystones than scored At/Above Benchmark on Star. Both Star At/Above and Keystone Proficient/Advanced were highest for 10<sup>th</sup> graders. Students usually take the Literature Keystone in 10<sup>th</sup> grade.

The predictive values shown for the entire sample in Table 8 are the same as shown in Table 6. When looking at the predictive value of the Winter Star Reading Assessment by grade, the positive predictive value was highest for 10<sup>th</sup> graders (92%) and lower for 9<sup>th</sup> (78%) and 11<sup>th</sup> graders (79%). The negative predictive value was highest for 9<sup>th</sup> graders (90%) and lowest for 10<sup>th</sup> graders (70%).

The classification accuracy values (i.e. sensitivity and specificity) shown for the entire sample in Table 8 are the same as shown in Table 7. By grade, the sensitivity of the Winter Star Reading Assessment was highest for 10<sup>th</sup> graders (62%) and lowest for 11<sup>th</sup> graders (32%).

Table 8. Predictive values and classification accuracy of Winter Star Reading and Literature Keystone performance in 2021-22

Categories	Entire Analytic Sample	9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade
<b>n</b>	7204	166	5273	1750
<b>Keystone Prof/Adv</b>	40%	16%	48%	23%
<b>Star At/Above</b>	28%	14%	35%	10%
<b>Difference between Keystone and Star</b>	12%	2%	13%	13%
<b>Positive Predictive Value</b>	90%	78%	92%	79%
<b>Negative Predictive Value</b>	73%	90%	70%	80%
<b>Sensitivity</b>	57%	55%	62%	32%
<b>Specificity</b>	95%	96%	94%	97%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** The value in the *Entire Analytic Sample* column refers to all students who have a 2021-22 Literature Keystone score and a 2021-22 Winter Star Reading score, regardless of grade level.

**There was a 0.74 correlation between Winter Star Reading Unified Scale Scores and the Literature Keystone Scale Scores for all grades 9-11 students who took both the Literature Keystone and the Winter Star Reading in 2021-22.**

Across the entire sample of District students who took the 2021-22 Literature Keystone and the 2021-22 Winter Star Reading, there was a strong, positive correlation between Keystones performance and Star performance, at 0.74 (Table 9). For 10th graders, this correlation was slightly stronger at 0.76, but lower for 9<sup>th</sup> and 11<sup>th</sup> graders at 0.64 (for more information about correlations, see Box 2).

Table 9. Correlations between Winter Star Reading and Literature Keystone in 2021-22 by grade level

<b>Keystone Scale Score x Star Unified Scale Score</b>	<b>Entire Sample</b>	<b>9<sup>th</sup> grade</b>	<b>10<sup>th</sup> grade</b>	<b>11<sup>th</sup> grade</b>
<b>Pearson r-correlations</b>	0.74	0.64	0.76	0.64
<b>n-count</b>	7204	166	5273	1750

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Winter 1 testing window. This includes all students with a Literature Keystone score, regardless of whether they were enrolled in the Literature Keystone course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. Students in Grades 8 and 12 are included in the *Entire Sample* correlations. See Appendix C for the same analysis for students who took the Literature Keystone course during the 2021-22 school year. Students who score less than half correct on Star Reading are automatically assigned a score of 615 (Star Reading Unified Scale range = 600 to 1400). Correlations were re-estimated using an alternative Star Reading score called the Enterprise Scale Score. Like the Unified Scale Score, the Enterprise Scale Score indicates a student’s performance on Star Reading. Both are based on the underlying Rasch scale, however, the Enterprise scores are a non-linear transformation of those scores, whereas the Unified scores are a linear transformation of those scores. The correlation between the Enterprise Scale Score and Literature Keystone Scale Scores was 0.79, slightly higher than the correlation between the Unified Scale Scores and the Keystone Scale Scores.



## What is the relationship between 2021-22 Spring Star Reading performance and 2021-22 Literature Keystone performance for students in grades 9-11?

**Scoring At/Above Benchmark on Spring Star Reading had a 92% positive predictive value for scoring Proficient or Advanced on the Literature Keystone.**

Of all grades 9-11 students who took both the Literature Keystone and the Spring Star Reading in 2021-22, 92% of students who scored At/Above Benchmark (the highest performance group) on Star Reading also scored Proficient or Advanced on the Literature Keystone (Table 10). This means that scoring At/Above Benchmark on Spring Star Reading had a 92% **positive predictive value** for scoring Proficient or Advanced on the Literature Keystone.

In comparison, 71% of students who scored On Watch, Strategic Intervention, or Intensive Intervention on Spring Star Reading also scored Basic or Below Basic on the Literature Keystone. Thus, scoring lower than At/Above Benchmark on Spring Star Reading had a 71% **negative predictive value** for scoring lower than Proficient or Advanced on the Literature Keystone.

Table 10. Positive and Negative Predictive Values: Percentage of students scoring Proficient or Advanced on the Literature Keystone by whether they scored At or Above Benchmark on Spring Star Reading in 2021-22

Spring Star Performance Groups	Number of Students	Keystone Performance Groups	
		Proficient or Advanced	Basic or Below Basic
<b>At/Above Benchmark</b>	1526	92%	8%
<b>On Watch, Strategic, and Intensive</b>	3869	29%	71%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Spring testing window. This includes all students with a Literature Keystone score, regardless of whether they were enrolled in the Literature Keystone course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. See Table A2 for breakouts by On Watch, Strategic Intervention, and Intensive Intervention Star performance groups. See Appendix C for the same analysis for students who took the Literature Keystone course during the 2021-22 school year. The percentages in the rows sum to 100%, and the n-counts in each cell can be calculated by multiplying the percentages in the cell by the numbers in the *Number of Students* column.

**How to read this table:** This table presents the number of students who scored in At/Above or not At/Above Star performance groups, and the percentage of students in each Star performance group who scored in the Proficient or Advanced Keystone performance groups or the Basic or Below Basic Keystone performance groups. For example, 92% of students who scored At/Above in Star also scored Proficient or Advanced on Keystone.

Of all students in grades 9-11 who took both the Literature Keystone and the Spring Star Reading Assessment in 2021-22, 56% who scored Proficient or Advanced on the Literature Keystone also scored At/Above Benchmark (the highest performance group) on Star Reading (Table 11). This indicates 56% **sensitivity**, meaning students who scored Proficient or Advanced on the Literature Keystone were “correctly” identified by also scoring At/Above Benchmark on Spring Star Reading 56% of the time.

In comparison, 96% of students who scored Basic or Below Basic on the Literature Keystone also scored On Watch, Strategic Intervention, or Intensive Intervention on Star Reading. This indicates 96% **specificity**, meaning students who scored lower than Proficient or Advanced on the Literature Keystone were “correctly” identified by also scoring lower than At/Above Benchmark on Spring Star Reading 96% of the time.

Table 11. Sensitivity and Specificity: Percentage of students scoring At/Above Benchmark or not on Spring Star Reading by whether they Score Proficient or Advanced on the Literature Keystone in 2021-22

Keystone Performance Groups	Number of Students	Winter Star Performance Groups	
		At/Above Benchmark	On Watch, Strategic, and Intensive
<b>Proficient or Advanced</b>	2528	56%	44%
<b>Basic or Below Basic</b>	2867	4%	96%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Spring testing window. This includes all students with a Literature Keystone score, regardless of whether they were enrolled in the Literature Keystone course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. The percentages in the rows sum to 100%, and the n-counts in each cell can be calculated by multiplying the percentages in the cell by the numbers in the *Number of Students* column.

**How to read this table:** This table presents the number of students who scored in the Proficient or Advanced Keystone performance groups or the Basic or Below Basic Keystone performance groups, and the percentage of students in both Keystone performance groups who scored in the At/Above or not At/Above Star performance groups. For example, 56% of students who scored Proficient or Advanced on Keystone scored At/Above in Star also.

Across the entire sample, there was a 12% difference in the percentage of students who scored Proficient or Advanced on the Literature Keystone (40%) and scored in the Spring Star Reading At/Above Benchmark performance group (28%) (Table 12). A higher percentage of students scored Proficient/Advanced on the Keystone than scored At/Above Benchmark on Star.

The predictive values shown for the entire sample in Table 12 are the same as shown in Table 10. The positive predictive value of the Spring Star Reading Assessment was highest for 10<sup>th</sup> graders (93%) and lower for 9<sup>th</sup> and 11<sup>th</sup> graders (81%). The negative predictive value was highest for 9<sup>th</sup> graders (92%) and lowest for 10<sup>th</sup> graders (67%).

The classification accuracy values shown for the entire sample in Table 12 are the same as shown in Table 11. The sensitivity of the Spring Star Reading Assessment was higher for 9<sup>th</sup> (59%) and 10<sup>th</sup> (60%) graders and lowest for 11<sup>th</sup> graders (26%). Specificity did not differ much by grade (95%-98%).

Table 12. Predictive values and classification accuracy of Spring Star Reading and Literature Keystone performance in 2021-22

Categories	Entire Analytic Sample	9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade
<b>Number of Students</b>	5396	127	4027	1148
<b>Keystone Prof/Adv</b>	40%	16%	48%	23%
<b>Star At/Above</b>	28%	13%	35%	9%
<b>Difference between Keystone and Star</b>	12%	3%	13%	14%
<b>Positive Predictive</b>	92%	81%	93%	81%
<b>Negative Predictive Value</b>	70%	92%	67%	76%
<b>Sensitivity</b>	56%	59%	60%	26%
<b>Specificity</b>	96%	97%	95%	98%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** The value in the *Entire Analytic Sample* column refers to all students who have a 2021-22 Literature Keystone score and a Spring 2021-22 Star Reading score, regardless of grade level.

**There was a 0.70 correlation between Spring Star Reading Unified Scale Scores and the Literature Keystone Scale Scores for all grades 9-11 students who took both the Literature Keystone and the Spring Star Reading in 2021-22.**

Across the entire sample of District students who took the 2021-22 Literature Keystone and the 2021-22 Spring Star Reading assessment, there was a strong, positive correlation between Keystone performance and Star performance, at 0.70 (Table 13). For 10th graders, this correlation was a bit stronger at 0.73, but lower for 9<sup>th</sup> and 11<sup>th</sup> graders at 0.58 and 0.55, respectively.

Table 13. Correlations between Spring Star Reading and Literature Keystone in 2021-22 by grade level

Keystone Scale Score x Star Unified Scale Score	Entire Sample	9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade
<b>Pearson r-correlations</b>	0.70	0.58	0.73	0.55
<b>n-count</b>	5395	127	4027	1148

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Spring testing window. This includes all students with a Literature Keystone score, regardless of whether they were enrolled in the Literature Keystone course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. Students in Grades 8 and 12 are included in the Entire Sample correlations. See Appendix C for the same analysis for students who took the Literature Keystone course during the 2021-22 school year. Students who score less than half correct on Star Reading are automatically assigned a score of 615 (Star Reading Unified Scale range = 600 to 1400). Correlations were re-estimated using an alternative Star Reading score called the Enterprise Scale Score. Like the Unified Scale Score, the Enterprise Scale Score indicates a student’s performance on Star Reading. Both are based on the underlying Rasch scale; however, the Enterprise scores are a non-linear transformation of those scores whereas the Unified scores are a linear transformation of those scores. The correlation between the Enterprise Scale Score and Literature Keystone Scale Scores was 0.77, slightly higher than the correlation between the Unified Scale Scores and the Keystone Scale Scores.

## What is the relationship between 2021-22 Winter Star Math performance and 2021-22 Algebra 1 Keystone performance for students in grades 8-11?

**Scoring At/Above Benchmark on Winter Star Math had a 72% positive predictive value for scoring Proficient or Advanced on the Algebra 1 Keystone.**

Of all grades 8-11 students who took both the Algebra 1 Keystone and the Winter Star Math in 2021-22, 72% of students who scored At/Above Benchmark (the highest performance group) on Star Math also scored Proficient or Advanced on the Algebra 1 Keystone (Table 14). This means that scoring At/Above Benchmark on Winter Star Math had a 72% **positive predictive value** for scoring Proficient or Advanced on the Algebra 1 Keystone.

In comparison, 92% of students who scored On Watch, Strategic Intervention, or Intensive Intervention on Winter Star Math also scored Basic or Below Basic on the Algebra 1 Keystone. Thus, scoring lower than At/Above Benchmark on Winter Star Math had a 92% **negative predictive value** for scoring lower than Proficient or Advanced on the Algebra 1 Keystone.

Table 14. Positive and Negative Predictive Values: Percentage of students scoring Proficient or Advanced on the Algebra 1 Keystone by whether they scored At or Above Benchmark on Winter Star Math in 2021-22

Winter Star Performance Groups	Number of Students	Keystone Performance Groups	
		Proficient or Advanced	Basic or Below Basic
<b>At/Above Benchmark</b>	2116	72%	28%
<b>On Watch, Strategic, and Intensive</b>	9138	8%	92%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Keystone Scale Score and Star Math Unified Scale Score in the Winter 1 testing window. This includes all students with an Algebra 1 Keystone score, regardless of whether they were enrolled in an Algebra 1 course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. See Table B1 for breakouts by On Watch, Strategic Intervention, and Intensive Intervention Star performance groups. See Appendix D for the same analysis for students who took the Algebra 1 Keystone course during the 2021-22 school year. The percentages in the rows sum to 100%, and the n-counts in each cell can be calculated by multiplying the percentages in the cell by the numbers in the *Number of Students* column.

**How to read this table:** This table presents the number of students who scored in At/Above or not At/Above Star performance groups, and the percentage of students in each Star performance group who scored in the Proficient or Advanced Keystone performance groups or the Basic or Below Basic Keystone performance groups. For example, 72% of students who scored At/Above in Star also scored Proficient or Advanced on Keystone.

Of all students in grades 8-11 who took both the Algebra 1 Keystone and the Winter Star Math Assessment in 2021-22, 68% who scored Proficient or Advanced on the Algebra 1 Keystone also scored At/Above Benchmark (the highest performance group) on Star Math (Table 15). This indicates 68% **sensitivity**, meaning students who scored Proficient or Advanced on the Algebra 1 Keystone were “correctly” identified by also scoring At/Above Benchmark on Winter Star Math 68% of the time.

In comparison, 94% of the students who scored Basic or Below Basic on the Algebra 1 Keystone also scored On Watch, Strategic Intervention, or Intensive Intervention on Star Math. This indicates 94% **specificity**, meaning students who scored lower than Proficient or Advanced on the Algebra 1 Keystone were “correctly” identified by also scoring lower than At/Above Benchmark on Winter Star Math 94% of the time.

Table 15. Sensitivity and Specificity: Percentage of students scoring At/Above Benchmark or not on Winter Star Math by whether they Score Proficient or Advanced on the Algebra 1 Keystone in 2021-22

Keystone Performance Groups	Number of Students	Winter Star Performance Groups	
		At/Above Benchmark	On Watch, Strategic, and Intensive
<b>Proficient or Advanced</b>	2261	68%	32%
<b>Basic or Below Basic</b>	8942	6%	94%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Keystone Scale Score and Star Reading Unified Scale Score in the Winter 1 testing window. This includes all students with an Algebra 1 Keystone score, regardless of whether they were enrolled in an Algebra 1 course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. The percentages in the rows sum to 100%, and the n-counts in each cell can be calculated by multiplying the percentages in the cell by the numbers in the *Number of Students* column.

**How to read this table:** This table presents the number of students who scored in the Proficient or Advanced Keystone performance groups or the Basic or Below Basic Keystone performance groups, and the percentage of students in both Keystone performance groups who scored in the At/Above or not At/Above Star performance groups. For example, 68% of students who scored Proficient or Advanced on Keystone scored At/Above in Star also.

Across the entire sample, there was a 2% difference in the percentage of students who scored Proficient or Advanced on the Algebra 1 Keystone (17%) and scored in the Winter Star Math At/Above Benchmark performance group (19%) (Table 16). A slightly higher percentage of students scored At/Above Benchmark on Star than score Proficient/Advanced on the Keystone.

The predictive values for the entire sample shown in Table 16 are the same as shown in Table 14. The positive predictive value of the Winter Star Math Assessment was highest for 8<sup>th</sup> graders (85%) and lowest for 10<sup>th</sup> graders (48%). Students generally take the Algebra 1 Keystone in 9<sup>th</sup> grade. Additionally, 92% of students who did not score At/Above Benchmark on Star (e.g., scored On Watch, Strategic Intervention, or Intensive Intervention) also scored in the Keystone Basic or Below Basic performance groups—or a 92% negative predictive value. The negative predictive value was lowest for 8<sup>th</sup> graders (68%).

The classification accuracy values shown for the entire sample in Table 16 are the same as shown in Table 15. The Sensitivity of the Winter Star Math Assessment was highest for 8<sup>th</sup> graders (73%) and lowest for 10<sup>th</sup> and 11<sup>th</sup> graders (59%).

Table 16. Predictive values and classification accuracy of Winter Star Math in 2021-22 and Algebra 1 Keystone performance

Categories	Entire Analytic Sample	8 <sup>th</sup> grade	9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade
<b>Number of students</b>	7078	1167	6055	2716	1303
<b>Keystone Prof/Adv</b>	17%	58%	17%	9%	9%
<b>Star At/Above</b>	19%	51%	17%	13%	10%
<b>Difference between Keystone and Star</b>	2%	8%	0%	4%	1%
<b>Positive Predictive Value</b>	72%	85%	75%	48%	61%
<b>Negative Predictive Value</b>	92%	68%	93%	95%	95%
<b>Sensitivity</b>	68%	73%	68%	59%	59%
<b>Specificity</b>	94% <sup>12</sup>	81%	95%	92%	96%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** The value in the *Entire Analytic Sample* column refers to all students who have a 2021-22 Algebra 1 Keystone score and a Winter 2021-22 Star Math score, regardless of grade level.

<sup>12</sup> When students who took Star Math Spanish are excluded, Specificity decreases to 93%. There were no changes to the within grade level analyses.

**There was a 0.71 correlation between Winter Star Math Unified Scale Scores and the Algebra 1 Keystone Scale Scores for all grades 8-11 students who took both the Algebra 1 Keystone and the Winter Star Math in 2021-22.**

Across the entire sample of District students who took the 2021-22 Algebra 1 Keystone and the 2021-22 Winter Star Math assessment, there was a strong, positive correlation between Keystone performance and Star performance, at 0.71 (Table 17). For 9<sup>th</sup> graders, this correlation was a bit stronger at 0.73, but a bit weaker for 8<sup>th</sup> graders at .70, and moderately correlated for 10<sup>th</sup> and 11<sup>th</sup> graders at 0.67 and 0.66, respectively.

Table 17. Correlations between Winter Star Math and Algebra 1 Keystone in 2021-22 by grade level

<b>Keystone Scale Score x Star Unified Scale Score</b>	<b>Entire Sample</b>	<b>8<sup>th</sup> grade</b>	<b>9<sup>th</sup> grade</b>	<b>10<sup>th</sup> grade</b>	<b>11<sup>th</sup> grade</b>
<b>Pearson r-correlations</b>	0.71	0.70	0.73	0.67	0.66
<b>n-count</b>	11453	1167	6167	2769	1337

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Keystone Scale Score and Star Math Unified Scale Score in the Winter 1 testing window. This includes all students with an Algebra 1 Keystone score, regardless of whether they were enrolled in the Algebra 1 Keystone course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. Students in Grades 7 and 12 are included in the Entire Sample correlations. See Appendix D for the same analysis for students who took the Algebra 1 Keystone course during the 2021-22 school year.

## What is the relationship between 2021-22 Spring Star Math performance and 2021-22 Algebra 1 Keystone performance for students in grades 8-11?

**Scoring At/Above Benchmark on Spring Star Math had a 72% positive predictive value for scoring Proficient or Advanced on the Algebra 1 Keystone.**

Of all grades 8-11 students who took both the Algebra 1 Keystone and the Spring Star Math in 2021-22, 72% of students who scored At/Above Benchmark (the highest performance group) on Star Math also scored Proficient or Advanced on the Algebra 1 Keystone (Table 18). This means that scoring At/Above Benchmark on Spring Star Math had a 72% **positive predictive value** for scoring Proficient or Advanced on the Algebra 1 Keystone.

In comparison, 92% of students who scored On Watch, Strategic Intervention, or Intensive Intervention on Spring Star Math also scored Basic or Below Basic on the Algebra 1 Keystone. Thus, scoring lower than At/Above Benchmark on Spring Star Math had a 92% **negative predictive value** for scoring lower than Proficient or Advanced on the Algebra 1 Keystone.

Table 18. Positive and Negative Predictive Values: Percentage of students scoring Proficient or Advanced on the Algebra 1 Keystone by whether they scored At or Above Benchmark on Spring Star Math in 2021-22

Spring Star Performance Groups	Number of Students	Keystone Performance Groups	
		Proficient or Advanced	Basic or Below Basic
<b>At/Above Benchmark</b>	1925	72%	28%
<b>On Watch, Strategic, and Intensive</b>	7456	8%	92%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Keystone Scale Score and Star Math Unified Scale Score in the Spring testing window. This includes all students with an Algebra 1 Keystone score, regardless of whether they were enrolled in an Algebra 1 course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. See Table B2 for breakouts by On Watch, Strategic Intervention, and Intensive Intervention Star performance groups. See Appendix D for the same analysis for students who took the Algebra 1 Keystone course during the 2021-22 school year. The percentages in the rows sum to 100%, and the n-counts in each cell can be calculated by multiplying the percentages in the cell by the numbers in the *Number of Students* column.

**How to read this table:** This table presents the number of students who scored in At/Above or not At/Above Star performance groups, and the percentage of students in each Star performance group who scored in the Proficient or Advanced Keystone performance groups or the Basic or Below Basic Keystone performance groups. For example, 72% of students who scored At/Above in Star also scored Proficient or Advanced on Keystone.

Of all students in grades 8-11 who took both the Algebra 1 Keystone and the Spring Star Math Assessment in 2021-22, 69% who scored Proficient or Advanced on the Algebra 1 Keystone also scored At/Above Benchmark (the highest performance group) on Star Math (Table 19). This indicates 69% **sensitivity**, meaning students who scored Proficient or Advanced on the Algebra 1 Keystone were “correctly” identified by also scoring At/Above Benchmark on Spring Star Math 69% of the time.

In comparison, 93% of the students who scored Basic or Below Basic on the Algebra 1 Keystone also scored On Watch, Strategic Intervention, or Intensive Intervention on Star Math. This indicates 93% **specificity**, meaning students who scored lower than Proficient or Advanced on the Algebra 1 Keystone were “correctly” identified by also scoring lower than At/Above Benchmark on Spring Star Math 93% of the time.



Table 19. Sensitivity and Specificity: Percentage of students scoring At/Above Benchmark or not on Spring Star Math by whether they Score Proficient or Advanced on the Algebra 1 Keystone in 2021-22

Keystone Performance Groups	Number of Students	Spring Star Performance Groups	
		At/Above Benchmark	On Watch, Strategic, and Intensive
<b>Proficient or Advanced</b>	2025	69%	31%
<b>Basic or Below Basic</b>	7282	7%	93%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Keystone Scale Score and Star Reading Unified Scale Score in the Spring testing window. This includes all students with an Algebra 1 Keystone score, regardless of whether they were enrolled in an Algebra 1 course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. The percentages in the rows sum to 100%, and the n-counts in each cell can be calculated by multiplying the percentages in the cell by the numbers in the *Number of Students* column.

**How to read this table:** This table presents the number of students who scored in the Proficient or Advanced Keystone performance groups or the Basic or Below Basic Keystone performance groups, and the percentage of students in both Keystone performance groups who scored in the At/Above or not At/Above Star performance groups. For example, 69% of students who scored Proficient or Advanced on Keystone scored At/Above in Star also.

Across the entire sample, there was a 4% difference in the percentage of students who scored Proficient or Advanced on the Algebra 1 Keystone (17%) and scored in the Spring Star Math At/Above Benchmark performance group (21%) (Table 20). A slightly higher percentage of students scored At/Above Benchmark on Star than score Proficient/Advanced on the Keystone.

The predictive values shown for the entire sample in Table 20 are the same as shown in Table 18. The positive predictive value of the Spring Star Math Assessment was highest for 8<sup>th</sup> graders (84%) and lowest for 10<sup>th</sup> graders (46%). Additionally, 91% of students who did not score At/Above Benchmark on Star (e.g., scored On Watch, Strategic Intervention, or Intensive Intervention) also scored in the Keystone Basic or Below Basic performance groups—or a 91% negative predictive value. The negative predictive value was lowest for 8<sup>th</sup> graders (72%).

The classification accuracy values shown for the entire sample in Table 8 are the same as shown in Table 19. The sensitivity of the Spring Star Math Assessment was highest for 8<sup>th</sup> graders (78%) and lowest for 10<sup>th</sup> graders (50%).

Table 20. Predictive values and classification accuracy of Spring Star Math and Algebra 1 Keystone performance in 2021-22

Categories	Entire Analytic Sample	8 <sup>th</sup> grade	9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade
<b>Number of students</b>	6063	1167	6055	2716	1303
<b>Keystone Prof/Adv</b>	17%	58%	17%	9%	9%
<b>Star At/Above</b>	21%	53%	19%	12%	12%
<b>Difference between Keystone and Star</b>	4%	5%	2%	3%	3%
<b>Positive Predictive Value</b>	72%	84%	75%	46%	55%
<b>Negative Predictive Value</b>	91%	72%	92%	94%	93%
<b>Sensitivity</b>	69%	78%	70%	50%	52%
<b>Specificity</b>	93%	80%	94%	93%	94%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** The value in the *Entire Analytic Sample* column refers to all students who have a 2021-22 Algebra 1 Keystone score and a Spring 2021-22 Star Math score, regardless of grade level.

**There was a 0.72 correlation between Spring Star Math Unified Scale Scores and the Algebra 1 Keystone Scale Scores for all grades 8-11 students who took both the Algebra 1 Keystone and the Spring Star Math in 2021-22.**

Across the entire sample of District students who took the 2021-22 Algebra 1 Keystone and the 2021-22 Spring Star Math assessment, there was a strong, positive correlation between Keystone performance and Star performance, at 0.72 (Table 21). For 9<sup>th</sup> graders, this correlation was a bit stronger at 0.73, but a bit weaker for 8<sup>th</sup> graders at .70, and moderately correlated for 10<sup>th</sup> and 11<sup>th</sup> graders at 0.66 and 0.63, respectively.

Table 21. Correlations between Spring Star Math and Algebra 1 Keystones in 2021-22 by grade level

Keystone Scale Score x Star Unified Scale Score	Entire Sample	8 <sup>th</sup> grade	9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade
<b>Pearson r-correlations</b>	0.72	0.70	0.73	0.66	0.63
<b>n-count</b>	9583	1117	5177	2176	1026

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Keystone Scale Score and Star Math Unified Scale Score in the Spring testing window. This includes all students with an Algebra 1 Keystone score, regardless of whether they were enrolled an Algebra 1 course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. Students in Grades 7 and 12 are included in the Entire Sample correlations. See Appendix D for the same analysis for students who took the Algebra 1 Keystone course during the 2021-22 school year.

## Conclusions

Overall, the analysis revealed consistencies between Winter and Spring Star performance in relation to Keystone performance for both subjects, slight differences by grade level, and strong differences between the Keystone-Star relationship for reading assessments and math assessments.

### Reading assessments

The positive predictive values for the Winter and Spring Star Reading assessments were between 90%-92% (higher for Spring than Winter), suggesting that the likelihood a student would score Proficient or Advanced on the Literature Keystone given a score of At/Above Benchmark on Star Reading was between 90% and 92%. In terms of sensitivity, Star Reading At/Above Benchmark scores correctly identified students who scored Proficient or Advanced on the Keystone between 56%-57% of the time. Correlations were positive and strong (0.70-0.74) for the Star Reading Unified Scale Scores and Literature Keystone Scale Scores across 9<sup>th</sup> – 11<sup>th</sup> graders. However, 10<sup>th</sup> graders had the largest percentage of students scoring in the highest Star and Keystone performance groups, 10<sup>th</sup> graders had the highest positive predictive values and sensitivity, 9<sup>th</sup> graders had the lowest difference between the percentage of students scoring in the highest Star and Keystone performance groups, and 10<sup>th</sup> graders had the stronger correlations.

Critically, predictive values, classification accuracy, and correlations were slightly higher for the Spring Star assessment data than for Winter. This may be due to two overlapping reasons, 1) the Spring Star assessment window is very close to the Keystone assessment window, and 2) fewer students took Star during the Spring assessment window than the Winter window. This decline in Star participation may reflect that students who generally have lower performance on Star chose not to take the Spring Star Assessment or even not to attend school during the Spring testing window, since high school attendance rates are typically lower in the spring than during other times of the school year.<sup>13</sup>

In terms of negative predictive values, results showed that between 71%-73% of students who did not score At/Above Benchmark on Winter and Spring Star Reading also did not score Proficient or Advanced on the Keystone. When we look at specificity analyses, 95%-96% of students who scored lower than Proficient or Advanced on the Literature Keystone did not score At/Above Benchmark on Star Reading. This reveals four important outcomes: 1) positive predictive values were higher than negative predictive values for the reading assessments, 2) specificity was higher than sensitivity, 3) just shy of 30% of students who did not score At/Above Benchmark on Star Reading did score Proficient or Advanced on the Literature Keystone, and 4) almost 50% of students who scored Proficient or Advanced on the Literature Keystone did not perform At/Above Benchmark on Star Reading. Additional work is recommended to understand why over 40% of students who scored Proficient/Advanced on the Keystone were not correctly identified by Star.

It is also important to note that few 11<sup>th</sup> graders who took the Literature Keystone in 2021-22 took the corresponding English 2 course in 2021-22. Many students likely took English 2 in an earlier

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<sup>13</sup> For more information on end of year assessment participation, see: [philasd.org/research/2022/08/18/participation-and-performance-on-the-star-assessments-at-the-school-district-of-philadelphia-2021-22/](https://philasd.org/research/2022/08/18/participation-and-performance-on-the-star-assessments-at-the-school-district-of-philadelphia-2021-22/)

school year when they did not have the opportunity or chose not to take the Literature Keystone (more information can be found in Appendix C). When only students who took the corresponding English 2 course in 2021-22 were included in the analysis (in Appendix C), the correlations increased slightly from 0.70-0.74 to 0.72-0.75. These slight adjustments likely reflect both the reduced sample size and the increased accuracy of performance predictions when only including students who were more familiar with the Keystone assessment material.

## Math assessments

The positive predictive values for the Winter and Spring Star Math assessments were 72%, suggesting that the likelihood a student would score Proficient or Advanced on the Algebra 1 Keystone given a score of At/Above on Star Math was about 72%. In terms of sensitivity, Star Math At/Above Benchmark scores correctly identified students who scored Proficient or Advanced on the Keystone between 68%-69% of the time. Correlations were positive and strong (0.71-0.72) for the Winter or Spring Star Math Unified Scale Scores and Algebra 1 Keystone Scale Scores across grades 8-11. However, 8<sup>th</sup> graders had the largest percentage of students scoring in the highest Star and Keystone performance groups, 8<sup>th</sup> graders had the highest positive predictive value and sensitivity, and 9<sup>th</sup> graders had the lowest difference between the percentage of students scoring in the highest Star and Keystone performance groups, and 9<sup>th</sup> graders had the strongest correlations.

Classification accuracy was slightly lower for the Spring Star assessment data than the Winter, and correlations were slightly higher for the Spring Star assessment data than the Winter. These differences may be due to the reasons previously discussed for the reading assessments, however, it is also possible the changes over time are simply reflecting variation in performance that randomly occurs in a large population retaking similar assessments (e.g., Star) multiple times per year.

In terms of negative predictive values, 91%-92% of students who did not score At/Above Benchmark also did not score Proficient or Advanced on the Algebra 1 Keystone. Note that for Star Math, the negative predictive values were higher than the positive predictive values; just 8%-9% of students who did not score At/Above Benchmark on Star Math did score Proficient or Advanced on the Algebra 1 Keystone, while 28% of students who scored At/Above Benchmark on Star did not score Proficient or Advanced on the Keystone.

When looking at specificity, 93%-94% of students who scored lower than Proficient or Advanced on the Algebra 1 Keystone did not score in At/Above Benchmark on Star Math. Note here again that the specificity was higher than the sensitivity for Star Math; just 6%-7% of students who scored lower than Proficient or Advanced on the Algebra 1 Keystone scored At/Above Benchmark on Star Math, while 31%-32% of students who scored Proficient or Advanced on the Algebra 1 Keystone did not score At/Above Benchmark on Star Math.

It is also important to note that few 10<sup>th</sup> and 11<sup>th</sup> graders who took the Algebra 1 Keystone in 2021-22 took the corresponding Algebra 1 course in 2021-22. Many students likely took the corresponding Algebra 1 course in an earlier school year, when they did not have the opportunity or chose not to take the Algebra 1 Keystone (more information can be found in Appendix D). When only students who took the corresponding Algebra 1 course in 2021-22 were including in the

analysis (in Appendix D), the correlations increased slightly from 0.71-0.72 to 0.73-0.75. These slight adjustments likely reflect both the reduced sample size and the increased accuracy of performance predictions when only including students who were more familiar with the Keystone assessment material.

## Reading and Math analyses

There were very different patterns between the reading assessments and the math assessments in terms of general performance, prediction, and classification accuracy. Overall, the percentage of students scoring in the Proficient or Advanced performance groups was higher for the Literature Keystone (52%-53%) than Algebra 1 Keystone (17%-19%), and the percentage of students scoring At/Above Benchmark was higher for Star Reading (34%-35%) than Star Math (16%-17%).<sup>14</sup>

These performance differences overall are reflected by the potential predictive utility of Star and Keystones. For example, the higher positive predictive values and lower negative predictive values for Star Reading suggest that Star might be underestimating Literature Keystone performance. Similarly, the lower positive predictive values and higher negative predictive values for Star Math suggests that Star might be overestimating Algebra 1 Keystone performance. The cut scores that define the At/Above Benchmark performance groups for Star Reading and Star Math (40<sup>th</sup> percentile and 70<sup>th</sup> percentile respectively) may play an important role in the predictive accuracy of the Star assessments and should continue to be studied as more years of data become available.

## Goals and Leading Indicators

SDP uses Star assessments to track District-wide progress toward Goal 4, the percentage of students who are proficient on the Keystone exams. It is expected that performance on the Leading Indicators is related to performance on the Keystone exams, such that the percentage of students scoring at or above grade-level on the within-year assessment (Star) can be used to estimate the percentage of students who will score in the Proficient and Advanced categories on the Keystones. If there is growth in the percentage of students scoring at or above grade-level on the District's within-year reading and math assessments that are administered multiple times per year, then the percentage of students who score in the Proficient and Advanced categories on the Keystone exams should similarly increase.

Based on the results in this report, the relationship between Star and Keystones are strong overall. However, when we look closely at specific grades, we see that the predictive value of Star is limited for students who took the Keystone exam in a different year than they took the respective Keystone course (See Appendix C and Appendix D for analyses that only include students who took the Keystone exam in the same year they took the Keystone course).

Importantly, the statistical relationship between Star and the Keystones is limited by our sample of students who took the respective assessments required to be included in the analysis. This means that our analyses are not generalizable to the entire SDP high school population, as fewer than half of SDP students who took the Keystone assessments took the respective Star assessment. Given our understanding of the 2021-22 school year, that high schools prioritized Keystone administration

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<sup>14</sup> The two values in the parentheses represent the distinct values from the Winter and Spring analyses.

over Star administration when faced with the choice, this analysis will need to be repeated with 2022-23 data to have a more generalizable representation of the within-year relationships between Star and Keystones, and completed with multiple years of Best by 11<sup>th</sup> Keystone data to better understand the predictive nature of Star for supporting Goal 4. Analyses in future years will help determine whether we should consider adjusting the Leading Indicator cut scores in order to better predict Keystone performance and support the SDP Board of Education's Goal 4 on Keystone performance.

## Appendix A

This table presents the number of students who scored in the four Winter Star Reading performance groups and the percentage of students in each group who scored in the four Literature Keystone performance groups (Table A1). Of students who scored At/Above Benchmark (the highest performance group) on Star Reading, 90% of students also scored Proficient or Advanced on the Literature Keystone. Of students who scored On Watch on Star Reading, 63% also scored Proficient or Advanced on the Literature Keystone, and 36% scored in the Basic or Below Basic.

Table A1. Percentage of students scoring in each Literature Keystone performance group by their Winter Star Reading performance group in 2021-22

Winter Star Performance Groups	Number of Students	Keystone Performance Groups			
		Advanced	Proficient	Basic	Below Basic
<b>At/Above (40-100)</b>	2049	18%	72%	9%	1%
<b>On Watch (25-39)</b>	990	1%	62%	32%	4%
<b>Strategic (10-24)</b>	1391	0%	37%	53%	10%
<b>Intensive (1-9)</b>	2774	0%	8%	41%	51%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Winter 1 testing window. This includes all students with a Literature Keystone score, regardless of whether they were enrolled in the Literature Keystone course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.

This table presents the number of students who scored in the four Spring Star Reading performance groups and the percentage of students in each group who scored in the four Literature Keystone performance groups. Of students who scored At/Above Benchmark on Star Reading, 92% of students also scored Proficient or Advanced on the Literature Keystone (Table A2). Of students who scored On Watch on Star Reading, 63% also scored Proficient or Advanced on the Literature Keystone, and 37% scored Basic or Below Basic on the Literature Keystone.

Table A2. Percentage of students scoring in each Literature Keystone performance group by their Spring Star Reading performance group in 2021-22

Spring Star Performance Groups	Number of Students	Keystone Performance Groups			
		Advanced	Proficient	Basic	Below Basic
<b>At/Above (40-100)</b>	1526	18%	74%	7%	1%
<b>On Watch (25-39)</b>	685	1%	62%	34%	3%
<b>Strategic (10-24)</b>	1006	0%	41%	50%	8%
<b>Intensive (1-9)</b>	2178	0%	12%	42%	45%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Spring testing window. This includes all students with a Literature Keystone score, regardless of whether they were enrolled in the Literature Keystone course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.

## Appendix B

This table presents the number of students who scored in each of the four Winter Star Math performance groups and the percentage of students in each group who scored in each of the four Algebra 1 Keystone performance groups. Of students who scored At/Above Benchmark (the highest performance group) on Star Math, 72% of students also scored Proficient or Advanced on the Algebra 1 Keystone (Table B1). Of students who scored On Watch on Star Math, 16% also scored Proficient or Advanced on the Algebra 1 Keystone, and 86% scored Basic or Below Basic.

Table B1. Percentage of students scoring in each Algebra 1 Keystones performance group by their Winter Star Math performance group in 2021-22

Winter Star Performance Groups	Number of Students	Keystone Performance Groups			
		Advanced	Proficient	Basic	Below Basic
<b>At/Above (70-100)</b>	2116	36%	36%	24%	3%
<b>On Watch (25-69)</b>	4345	2%	14%	61%	23%
<b>Strategic (10-24)</b>	1949	0%	1%	32%	67%
<b>Intensive (1-9)</b>	2844	0%	0%	11%	89%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Scale Score and Star Math Unified Scale Score in the Winter 1 testing window. This includes all students with an Algebra 1 Keystone score, regardless of whether they were enrolled in an Algebra 1 course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.

This table presents the number of students who scored in each of the four Spring Star Reading performance groups and the percentage of students in each group who scored in each of the four Algebra 1 Keystone performance groups. Of students who scored At/Above Benchmark (the highest performance group) on Star Math, 72% of students also scored Proficient or Advanced on the Algebra 1 Keystone (Table B2). Of students who scored On Watch on Star Reading, 17% also scored Proficient or Advanced on the Algebra 1 Keystone, and 83% scored Basic or Below Basic.

Table B2. Percentage of students scoring in each Algebra 1 Keystone performance group by their Spring Star Math performance group in 2021-22

Spring Star Performance Groups	Number of Students	Keystone Performance Groups			
		Advanced	Proficient	Basic	Below Basic
<b>At/Above (70-100)</b>	1925	37%	35%	24%	3%
<b>On Watch (25-69)</b>	3390	2%	15%	62%	21%
<b>Strategic (10-24)</b>	1393	0%	2%	39%	59%
<b>Intensive (1-9)</b>	2673	0%	1%	13%	86%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Scale Score and Star Math Unified Scale Score in the Spring testing window. This includes all students with an Algebra 1 Keystone score, regardless of whether they were enrolled in an Algebra 1 course during the 2021-22 school year. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.



## Appendix C

**The Winter Star Reading Assessment shows a slightly higher positive predictive value and sensitivity when looking only at students who took the Literature Keystone in the same year that they completed English 2, the corresponding literature course.**

Of all grades 9-11 students who were enrolled in and earned a final grade in English 2 in 2021-22 and took both the Literature Keystone and the Winter Star Reading in 2021-22, 92% of students who scored At/Above Benchmark on Star Reading also scored Proficient or Advanced on the Literature Keystone (Table C1. – or a 92% positive predictive value for scoring Proficient or Advanced on the Literature Keystone. This calculation for students who completed English 2 in the same year that they took the Literature Keystone includes fewer students and yields a slightly higher positive predictive value than the calculation for the entire analytic sample (Table 6).

In comparison, 70% of 2021-22 English 2 students who scored On Watch, Strategic Intervention, or Intensive Intervention on Winter Star Reading also scored Basic or Below Basic on the Literature Keystone (Table C1. – or a 70% negative predictive value. This calculation yields a slightly lower negative predictive value than the calculation for the entire analytic sample (Table 6).

Table C1. Positive and Negative Predictive Values: Percentage of students scoring Proficient or Advanced on the Literature Keystone by whether they scored At or Above Benchmark on Winter Star Reading in 2021-22 for students who completed English 2 in 2021-22

Winter Star Performance Groups	Number of Students	Keystone Performance Groups	
		Proficient or Advanced	Basic or Below Basic
<b>At/Above Benchmark</b>	1862	92%	8%
<b>On Watch, Strategic, and Intensive</b>	3500	30%	70%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Winter 1 testing window *who also* completed English 2 (the Literature Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.

This table presents the numbers of students who scored in each of the four Winter Star Reading performance groups, and the percentage of students in each group who scored in each of the four Keystone performance groups out of students who took English 2 and earned a final English 2 grade in 2021-22 (Table C2). Of students who scored At/Above Benchmark (the highest performance group) on Star Reading, 92% of students also scored Proficient or Advanced on the Literature Keystone (percentages may sum to more or less than 100% due to rounding). Of students who scored On Watch on Star Reading, 65% also scored Proficient or Advanced on the Literature Keystone, and 35% scored in the Basic or Below Basic on the Literature Keystone.

Table C2. Percentage of students scoring in each Literature Keystone performance group by their Winter Star Reading performance group in 2021-22 for students who completed English 2 in 2021-22

Winter Star Performance Groups	Number of Students	Keystone Performance Groups			
		Advanced	Proficient	Basic	Below Basic
<b>At/Above (40-100)</b>	1862	19%	72%	8%	1%
<b>On Watch (25-39)</b>	788	1%	64%	30%	5%
<b>Strategic (10-24)</b>	1024	0%	38%	51%	11%
<b>Intensive (1-9)</b>	1688	0%	9%	40%	51%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Winter 1 testing window *who also* completed English 2 (the Literature Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.

Of all grades 9-11 students who were enrolled in and earned a final grade in English 2 in 2021-22 *and* took both the Literature Keystone and the Winter Star Reading in 2021-22, 62% who scored Proficient or Advanced on the Literature Keystone also scored At/Above Benchmark (the highest performance group) on Star Reading (Table C3) – or a 62% sensitivity.

In comparison, 94% of 2021-22 English 2 students who scored in Basic or Below Basic on the Literature Keystone also scored in On Watch, Strategic Intervention, or Intensive Intervention on Star Reading – or a 94% specificity.

Table C3. Sensitivity and Specificity Values: Percentage of students scoring At/Above Benchmark or not on Winter Star Reading by whether they scored Proficient or Advanced on the Literature Keystone in 2021-22 for students who completed English 2 in 2021-22

Keystone Performance Groups	Number of Students	Winter Star Performance Groups	
		At/Above Benchmark	On Watch, Strategic, and Intensive
<b>Proficient or Advanced</b>	2764	62%	48%
<b>Basic or Below Basic</b>	2606	6%	94%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** The table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Winter 1 testing window *who also* completed English 2 (the Literature Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. The percentages in the rows sum to 100%, and the n-counts in each cell can be calculated by multiplying the percentages in the cell by the numbers in the *Number of Students* column.

**How to read this table:** This table presents the number of students who scored in the Proficient or Advanced Keystone performance groups or the Basic or Below Basic Keystone performance groups, and the percentage of students in both Keystone performance groups who scored in the At/Above or not At/Above Star performance groups. For example, 62% of students who scored Proficient or Advanced on Keystone also scored At/Above Benchmark in Star.

**There was a 0.75 correlation between Winter Star Reading Unified Scale Scores and the Literature Keystone Scale Scores in 2021-22 for grades 9-11 students who completed English 2 in 2021-22.**

Of all grades 9-11 students who were enrolled in and earned a final grade in English 2 in 2021-22 and took both the Literature Keystone and the Winter Star Reading in 2021-22, there was a strong, positive correlation between Keystone performance and Star performance, at 0.75 (Table C4). This correlation was the strongest for 10<sup>th</sup> graders, weaker for 9<sup>th</sup> graders at 0.63 and moderate for 11<sup>th</sup> graders at 0.53.

Table C4. Correlations between Winter Star Reading and Literature Keystone in 2021-22 by grade level for students who took English 2 in 2021-22

<b>Keystone Scale Score x Star Unified Scale Score</b>	<b>Entire Sample</b>	<b>9<sup>th</sup> grade</b>	<b>10<sup>th</sup> grade</b>	<b>11<sup>th</sup> grade</b>
<b>Pearson r-correlations</b>	0.75	0.63	0.75	0.53
<b>n-count</b>	5362	141	5158	55

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** The table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Winter 1 testing window *who also* completed English 2 (the Literature Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.

**The Spring Star Reading Assessment shows a slightly higher positive predictive value and sensitivity when looking only at students who took the Literature Keystone in the same year that they completed English 2, the corresponding literature course.**

Of all grades 9-11 students who were enrolled in and earned a final grade in English 2 in 2021-22 and took both the Literature Keystone and the Spring Star Reading in 2021-22, 93% of students who scored At/Above Benchmark (the highest performance group) on Star Reading also scored Proficient or Advanced on the Literature Keystone (Table C5) – or a 93% positive predictive value for scoring Proficient or Advanced on the Literature Keystone. This calculation for students who completed English 2 in the same year that they took the Literature Keystone includes fewer students and yields a slightly higher positive predictive value than the calculation for the entire analytic sample (Table 10).

In comparison, 68% of students who scored On Watch, Strategic Intervention, or Intensive Intervention on Spring Star Reading also scored Basic or Below Basic on the Literature Keystone (Table C5) – or a 68% negative predictive value for scoring lower than Proficient or Advanced on the Literature Keystone. This calculation yields a slightly lower negative predictive value than the calculation for the entire analytic sample (Table 10).

Table C5. Positive and Negative Predictive Values: Percentage of students scoring Proficient or Advanced on the Literature Keystone by whether they scored At or Above Benchmark on Spring Star Reading in 2021-22 for students who took English 2 in 2021-22

Winter Star Performance Groups	Number of Students	Keystone Performance Groups	
		Proficient or Advanced	Basic or Below Basic
<b>At/Above Benchmark</b>	1412	93%	7%
<b>On Watch, Strategic, and Intensive</b>	2718	32%	68%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** The table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Spring testing window *who also* completed English 2 (the Literature Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. See Table A4 for breakouts by On Watch, Strategic Intervention, and Intensive Intervention Star performance groups.

This table presents the numbers of students who scored in each of the four Spring Star Reading performance groups, and the percentage of students in each group who scored in each of the four Keystone performance groups out of students who took English 2 and earned a final English 2 grade in 2021-22 (Table C6). Of students who scored At/Above Benchmark on Star Reading, 93% of students also scored Proficient or Advanced on the Literature Keystone (percentages may sum to more or less than 100% due to rounding). Of students who scored On Watch on Star Reading, 64% also scored Proficient or Advanced on the Literature Keystone, and 36% scored in the Basic or Below Basic on the Literature Keystone.

Table C6. Percentage of students scoring in each Literature Keystone performance group by their Spring Star Reading performance group in 2021-22 for students who took English 2 in 2021-22

Winter Star Performance Groups	Number of Students	Keystone Performance Groups			
		Advanced	Proficient	Basic	Below Basic
<b>At/Above (40-100)</b>	1412	19%	74%	6%	0%
<b>On Watch (25-39)</b>	572	1%	63%	34%	2%
<b>Strategic (10-24)</b>	779	0%	43%	49%	8%
<b>Intensive (1-9)</b>	1367	0%	12%	42%	46%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** The population in this table is only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Spring testing window. This population is also only students who took English 2 (the Keystone Literature course) in 2021-22 and received a final grade for English 2. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.

Of all grades 9-11 students who were enrolled in and earned a final grade in English 2 in 2021-22 *and* took both the Literature Keystone and the Winter Star Reading in 2021-22, 60% who scored Proficient or Advanced on the Literature Keystone also scored At/Above Benchmark on Star Reading (Table C7) – or 60% sensitivity. In comparison, 95% of the students who scored Basic or Below Basic on the Literature Keystone also scored On Watch, Strategic Intervention, or Intensive Intervention on Star Reading – or 95% specificity.

Table C7. Sensitivity and Specificity Values: Percentage of students scoring At/Above Benchmark or not on Spring Star Reading by whether they Score Proficient or Advanced on the Literature Keystone in 2021-22 for students who took English 2 in 2021-22

Keystone Performance Groups	Number of Students	Winter Star Performance Groups	
		At/Above Benchmark	On Watch, Strategic, and Intensive
<b>Proficient or Advanced</b>	2186	60%	40%
<b>Basic or Below Basic</b>	1948	5%	95%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Spring testing window *who also* completed English 2 (the Literature Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. The percentages in the rows sum to 100%, and the n-counts in each cell can be calculated by multiplying the percentages in the cell by the numbers in the *Number of Students* column.

**How to read this table:** This table presents the number of students who scored in the Proficient or Advanced Keystone performance groups or the Basic or Below Basic Keystone performance groups, and the percentage of students in both Keystone performance groups who scored in the At/Above or not At/Above Star performance groups. For example, 60% of students who scored Proficient or Advanced on Keystone also scored At/Above Benchmark in Star.

**There was a 0.72 correlation between Spring Star Reading Unified Scale Scores and the Literature Keystone Scale Scores in 2021-22 for grades 9-11 students who completed English 2 in 2021-22.**

Of all grades 9-11 students who were enrolled in and earned a final grade in English 2 in 2021-22 *and* took both the Literature Keystone and the Winter Star Reading in 2021-22, there was a strong, positive correlation between Keystone performance and Star performance, at 0.72 (Table C8). This correlation was the strongest for 10<sup>th</sup> graders and weaker for 9<sup>th</sup> graders and 11<sup>th</sup> graders at 0.56 and 0.57 respectively.

Table C8. Correlations between Spring Star Reading and Literature Keystone in 2021-22 by grade level for students who took English 2 in 2021-22

Keystone Scale Score x Star Unified Scale Score	Entire Sample	9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade
<b>Pearson r-correlations</b>	0.72	0.56	0.72	0.57
<b>n-count</b>	4130	106	3950	51

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with a Literature Keystone Scale Score and Star Reading Unified Scale Score in the Spring testing window *who also* completed English 2 (the Literature Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.

## Appendix D

The Winter Star Math Assessment shows a higher positive predictive value and a slightly higher sensitivity when looking only at students who took the Algebra 1 Keystone in the same year that they completed Algebra 1, the corresponding math course.

Of all grades 8-11 students who were enrolled in and earned a final grade in Algebra 1 in 2021-22 and took both the Algebra 1 Keystone and the Winter Star Math in 2021-22, 78% students who scored At/Above Benchmark (the highest performance group) on Star Math also scored Proficient or Advanced on the Algebra 1 Keystone (Table D1) – or a 78% positive predictive value. This calculation for students who completed Algebra 1 in the same year that they took the Algebra 1 Keystone includes fewer students and yields a slightly higher positive predictive value than the calculation for the entire analytic sample (Table 14).

In comparison, 90% of students who scored On Watch, Strategic Intervention, or Intensive Intervention on Winter Star Math also scored Basic or Below Basic on the Algebra 1 Keystone (Table D1) – or a 90% negative predictive value for scoring lower than Proficient or Advanced on the Algebra 1 Keystone. This calculation yields a slightly lower negative predictive value than the calculation for the entire analytic sample (Table 14).

Table D1. Positive and Negative Predictive Values: Percentage of students scoring Proficient or Advanced on the Algebra 1 Keystone by whether they scored At or Above Benchmark on Winter Star Math in 2021-22 for students who took Algebra 1 in 2021-22

Winter Star Performance Groups	Number of Students	Keystone Performance Groups	
		Proficient or Advanced	Basic or Below Basic
At/Above Benchmark	1501	78%	22%
On Watch, Strategic, and Intensive	5577	10%	90%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Keystone Scale Score and Star Math Unified Scale Score in the Winter 1 testing window *who also* completed Algebra 1 (the Algebra 1 Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. See Table B2 for breakouts by On Watch, Strategic Intervention, and Intensive Intervention Star performance groups.

Table D2 presents the numbers of students who scored in each of the four Winter Star Math performance groups, and the percentage of students in each group who scored in each of the four Keystone performance groups out of students who took Algebra 1 and earned a final Algebra 1 grade in 2021-22. Of students who scored At/Above Benchmark (the highest performance group) on Star Math, 78% of students also scored Proficient or Advanced on the Algebra 1 Keystone (percentages may sum to more or less than 100% due to rounding). Of students who scored On Watch on Star Math, 19% also scored Proficient or Advanced on the Algebra 1 Keystone, and 80% scored in the Basic or Below Basic on the Algebra 1 Keystone.

Table D2. Percentage of students scoring in each Algebra 1 Keystone performance group by their Winter Star Math performance group in 2021-22 for students who took the Algebra 1 course in 2021-22

Winter Star Performance Groups	Number of Students	Keystone Performance Groups			
		Advanced	Proficient	Basic	Below Basic
<b>At/Above (70-100)</b>	1501	41%	36%	19%	3%
<b>On Watch (25-69)</b>	2673	3%	16%	56%	24%
<b>Strategic (10-24)</b>	1168	0%	1%	30%	69%
<b>Intensive (1-9)</b>	1736	0%	0%	8%	92%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only student with an Algebra 1 Scale Score and Star Math Unified Scale Score in the Winter 1 testing window *who also* completed Algebra 1 (the Algebra 1 Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.

Of all grades 8-11 students who were enrolled in and earned a final grade in Algebra 1 in 2021-22 *and* took both the Algebra 1 Keystone and the Winter Star Math in 2021-22, 69% who scored Proficient or Advanced on the Algebra 1 Keystone also scored At/Above Benchmark (the highest performance group) on Star Math (Table D3) - or 69% sensitivity. In comparison, 94% of the students who scored Basic or Below Basic on the Algebra 1 Keystone also scored On Watch, Strategic Intervention, or Intensive Intervention on Star Math – or 94% specificity.

Table D3. Sensitivity and Specificity Values: Percentage of students scoring At/Above Benchmark or not on Winter Star Math by whether they Score Proficient or Advanced on the Algebra 1 Keystone in 2021-22 for students who took Algebra 1 in 2021-22

Keystone Performance Groups	Number of Students	Winter Star Performance Groups	
		At/Above Benchmark	On Watch, Strategic, and Intensive
<b>Proficient or Advanced</b>	1731	69%	41%
<b>Basic or Below Basic</b>	5404	6%	94%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Keystone Scale Score and Star Math Unified Scale Score in the Winter 1 testing window *who also* completed Algebra 1 (the Algebra 1 Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. The percentages in the rows sum to 100%, and the n-counts in each cell can be calculated by multiplying the percentages in the cell by the numbers in the *Number of Students* column.

**How to read this table:** This table presents the number of students who scored in the Proficient or Advanced Keystone performance groups or the Basic or Below Basic Keystone performance groups, and the percentage of students in both Keystone performance groups who scored in the At/Above or not At/Above Star performance groups. For example, 69% of students who scored Proficient or Advanced on Keystone also scored At/Above Benchmark in Star.

**There was a 0.73 correlation between Winter Star Math Unified Scale Scores and the Algebra 1 Keystone Scale Scores in 2021-22 for grades 8-11 students who completed Algebra 1 in 2021-22.**

Of all grades 8-11 students who were enrolled in and earned a final grade in Algebra 1 in 2021-22 and took both the Algebra 1 Keystone and Winter Star Math in 2021-22, there was a strong, positive correlation between Keystone performance and Star performance, at 0.73 (Table D4). This correlation was the strongest for 9<sup>th</sup> graders and weaker for 8<sup>th</sup> graders at 0.70 and 10<sup>th</sup> graders at 0.62. The correlation was lowest for 11<sup>th</sup> graders, however, with only 14 11<sup>th</sup> graders in the sample, the result for 11<sup>th</sup> graders should be interpreted with caution.

Table D4. Correlations between Winter Star Math and Algebra 1 Keystone in 2021-22 by grade level for students who took Algebra 1 in 2021-22

Keystone Scale Score x Star Unified Scale Score	Entire Sample	8 <sup>th</sup> grade	9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade
<b>Pearson r-correlations</b>	0.73	0.7	0.72	0.62	0.34
<b>n-count</b>	7189	1127	5931	114	14

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Keystone Scale Score and Star Math Unified Scale Score in the Winter 1 testing window who also completed Algebra 1 (the Algebra 1 Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.

**The Spring Star Math Assessment shows a higher positive predictive value and sensitivity when looking only at students who took the Algebra 1 Keystone in the same year that they completed Algebra 1, the corresponding math course.**

Of all grades 8-11 students who were enrolled in and earned a final grade in Algebra 1 in 2021-22 and took both the Algebra 1 Keystone and the Spring Star Math in 2021-22, 77% of students who scored At/Above Benchmark (the highest performance group) on Star Math also scored Proficient or Advanced on the Algebra 1 Keystone (Table D5) – or a 77% positive predictive value. This calculation for students who completed Algebra 1 in the same year that they took the Algebra 1 Keystone includes fewer students and yields a slightly higher positive predictive value than the calculation for the entire analytic sample (Table 18).

In comparison, 91% of students who scored On Watch, Strategic Intervention, or Intensive Intervention on Spring Star Math also scored Basic or Below Basic on the Algebra 1 Keystone (Table D5) – or a 91% negative predictive value. This calculation yields a slightly lower negative predictive value than the calculation for the entire analytic sample (Table 18).



Table D5. Positive and Negative Predictive Values: Percentage of students scoring Proficient or Advanced on the Algebra 1 Keystone by whether they scored At or Above Benchmark on Spring Star Math in 2021-22 for students who took Algebra 1 in 2021-22

Winter Star Performance Groups	Number of Students	Keystone Performance Groups	
		Proficient or Advanced	Basic or Below Basic
<b>At/Above Benchmark</b>	1501	77%	23%
<b>On Watch, Strategic, and Intensive</b>	5577	9%	91%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Keystone Scale Score and Star Math Unified Scale Score in the Spring testing window *who also* completed Algebra 1 (the Algebra 1 Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. See Table B4 for breakouts by On Watch, Strategic Intervention, and Intensive Intervention Star performance groups.

This table presents the numbers of students who scored in each of the four Spring Star Math performance groups, and the percentage of students in each group who scored in each of the four Keystone performance groups out of students who took Algebra 1 and earned a final Algebra 1 grade in 2021-22. (Table D6). Of students who scored At/Above Benchmark (the highest performance group) on Star Math, 77% of students also scored Proficient or Advanced on the Algebra 1 Keystone (percentages may sum to more or less than 100% due to rounding). Of students who scored On Watch on Star Math, 19% also scored Proficient or Advanced on the Algebra 1 Keystone, and 81% scored in the Basic or Below Basic on the Algebra 1 Keystone.

Table D6. Percentage of students scoring in each Algebra 1 Keystone performance group by their Spring Star Math performance group in 2021-22 for students who took the Algebra 1 course in 2021-22

Winter Star Performance Groups	Number of Students	Keystone Performance Groups			
		Advanced	Proficient	Basic	Below Basic
<b>At/Above (70-100)</b>	1432	41%	36%	20%	3%
<b>On Watch (25-69)</b>	2162	3%	16%	58%	23%
<b>Strategic (10-24)</b>	858	0%	2%	36%	62%
<b>Intensive (1-9)</b>	1611	0%	1%	10%	89%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Scale Score and Star Math Unified Scale Score in the Spring testing window *who also* completed Algebra 1 (the Algebra 1 Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.

Of all grades 8-11 students who were enrolled in and earned a final grade in Algebra 1 in 2021-22 *and* took both the Algebra 1 Keystone and the Spring Star Math in 2021-22, 72% who scored Proficient or Advanced on the Algebra 1 Keystone also scored At/Above Benchmark (the highest performance group) on Star Math (Table D7) – or 72% sensitivity. In comparison, 93% of the

students who scored Basic or Below Basic on the Algebra 1 Keystone also scored On Watch, Strategic Intervention, or Intensive Intervention on Star Math – or 93% specificity.

Table D7. Sensitivity and Specificity Values: Percentage of students scoring At/Above Benchmark or not on Spring Star Math by whether they Score Proficient or Advanced on the Algebra 1 Keystone in 2021-22 for students who took Algebra 1 in 2021-22

Keystone Performance Groups	Number of Students	Winter Star Performance Groups	
		At/Above Benchmark	On Watch, Strategic, and Intensive
<b>Proficient or Advanced</b>	1578	72%	28%
<b>Basic or Below Basic</b>	4542	7%	93%

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Keystone Scale Score and Star Math Unified Scale Score in the Spring testing window *who also* completed Algebra 1 (the Algebra 1 Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years. The percentages in the rows sum to 100%, and the n-counts in each cell can be calculated by multiplying the percentages in the cell by the numbers in the *Number of Students* column.

**How to read this table:** This table presents the number of students who scored in the Proficient or Advanced Keystone performance groups or the Basic or Below Basic Keystone performance groups, and the percentage of students in both Keystone performance groups who scored in the At/Above or not At/Above Star performance groups. For example, 72% of students who scored Proficient or Advanced on Keystone also scored At/Above Benchmark in Star.

### There was a 0.75 correlation between Spring Star Math Unified Scale Scores and the Algebra 1 Keystone Scale Scores in 2021-22 for grades 8-11 students who completed Algebra 1 in 2021-22.

Of all grades 8-11 students who were enrolled in and earned a final grade in Algebra 1 in 2021-22 *and* took both the Algebra 1 Keystone and Spring Star Math in 2021-22, there was a strong, positive correlation between Keystone performance and Star performance, at 0.75 (Table D8). This correlation was the strongest for 9<sup>th</sup> graders at 0.72, weaker for 8<sup>th</sup> graders at 0.70, and moderate for 10<sup>th</sup> graders at 0.55. The correlation was lowest for 11<sup>th</sup> graders; however, with a sample of only 27 students, the result for 11<sup>th</sup> graders should be interpreted with caution.

Table D8. Correlations between Spring Star Math and Algebra 1 Keystone in 2021-22 by grade level for students who took Algebra 1 in 2021-22

Keystone Scale Score x Star Unified Scale Score	Entire Sample	8 <sup>th</sup> grade	9 <sup>th</sup> grade	10 <sup>th</sup> grade	11 <sup>th</sup> grade
<b>Pearson r-correlations</b>	0.75	0.7	0.72	0.55	0.28
<b>n-count</b>	6184	1077	4963	109	27

**Source:** Qlik Report Library Academic Screeners, Accessed July 26, 2022, Qlik Report Library PSSA and Keystones, Accessed September 6, 2022

**Note:** This table includes only students with an Algebra 1 Keystone Scale Score and Star Math Unified Scale Score in the Spring testing window *who also* completed Algebra 1 (the Algebra 1 Keystone course) in 2021-22. This analysis only includes Keystone performance during the 2021-22 school year, not Best by 11<sup>th</sup> scores from earlier years.